

# Gus Simmons Wins Lawrence Award

Gus Simmons, manager of Applied Mathematics Department 1640, has been selected to receive one of DOE's top awards for scientific achievement, the Ernest Orlando Lawrence Memorial Award. The award is given for outstanding contributions in fields of science and engineering related to atomic energy.

Gus and five other scientists from around the country will receive a gold medal and a \$10,000 prize from Energy Secretary John Herrington at a ceremony at DOE headquarters in Washington on Sept. 11.

Gus becomes Sandia's third recipient of the prize, and the second in less than a year. Last October Gordon Osbourn (now 1143) was named to receive the 1985 prize for his work on the theory underlying the strained-layer superlattice. The only other Sandia recipient has been Executive Vice President Tom Cook, who won the award in 1971 for his studies of nuclear weapons effects.

A mathematician and cryptologist, Gus was recognized "for contributions to national security through application of advanced mathematics to the command and control of nuclear weapons, especially in establishing the field of authentication as a central element of public key cryptography."

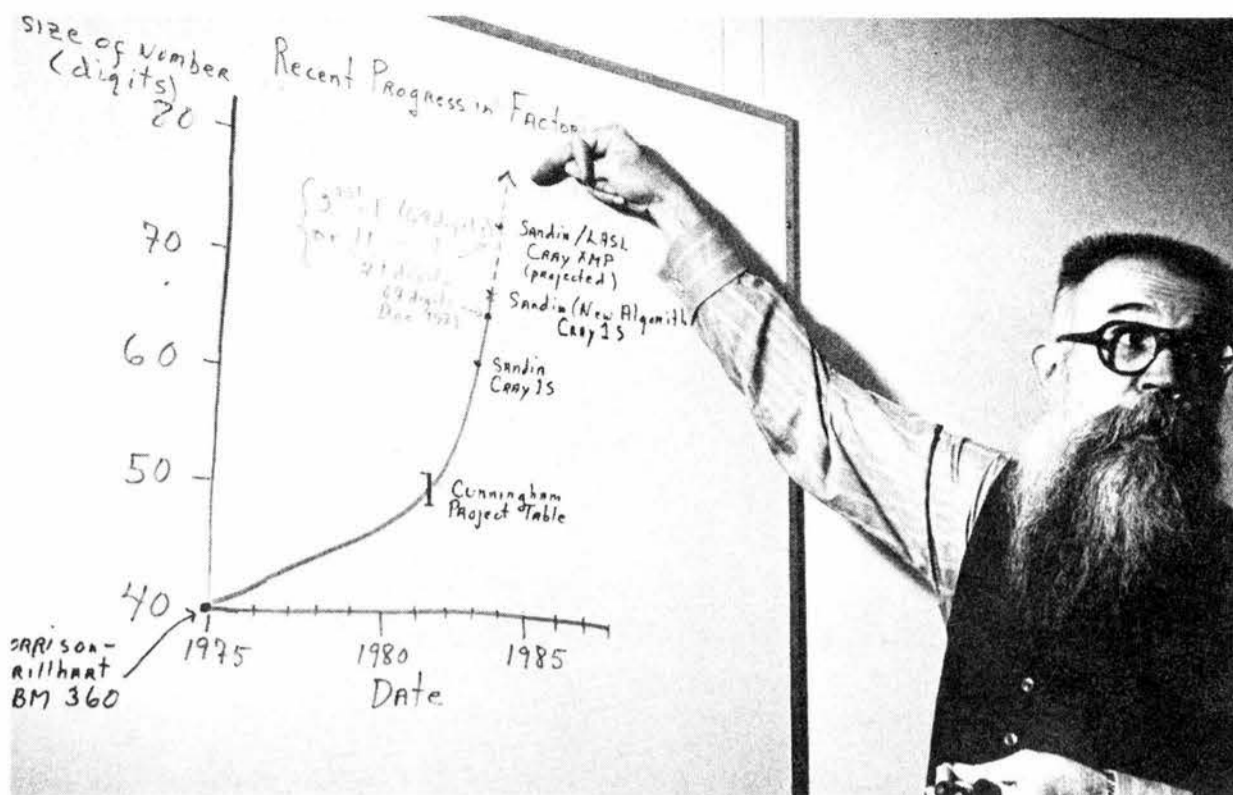
Said Herrington in announcing the awards, "I am proud to honor these outstanding scientists and engineers for their dedication, effort, and contributions to science and the nation."

"Gus is internationally recognized for his many contributions to cryptology," said Bill Brinkman, Vice President for Research 1000. "The award of the E. O. Lawrence Prize recognizes his contributions to command and control of nuclear weapons, which is most fitting. Gus is a truly stimulating, innovative person who has made many contributions to Sandia."

The DOE noted that Gus's contributions to command and control of nuclear weapons range over many areas. These include the concept of secure information containers, code management of exclusion switches, two-key cryptographic systems, the entire field of authentication (including shared secret authentication algorithms), the application of large-number factoring algorithms to cryptanalysis, and (with Ernie Brickell, now at Bell Communications) the cryptanalysis of "knapsack" cryptoalgorithms. In the area of pure mathematics, Gus is a recognized leader in the field of discrete systems and combinatorics.

The DOE cited the increasing importance in the nuclear era's political climate of control features on nuclear weapons, including verification, authentication, and positive use control: "This is the first time that achievements in this field, of vital importance to national security, have been recognized by a Lawrence Award."

The Lawrence Award was established in 1959 to honor the memory of Ernest Orlando Lawrence, who invented the cyclotron and after whom the two major laboratories at Berkeley and Livermore were named.



GUS MADE TIME — Back in February 1984, TIME Magazine ran this Bill Laskar photo of Gus (1640) in a story, "Cracking a Record Number," dealing with the 69-digit number that had been factored by Jim Davis, Diane Holdridge (both 1641), and Gus.

## Four Milestones

### Success Bought a License — To Do Interesting Things

Gus Simmons may be in a field, mathematics, that some view as narrow and specialized, but he has had a surprisingly diverse career at Sandia. His 26 years at Sandia span a 32-year period (he has left and come back four times, which caused one of his former directors to jokingly say that he came to Sandia only between jobs).

He credits both the freedom to pursue new ideas that Sandia grants and the stimulation of real-world challenges from other parts of the Laboratories for the success and enjoyment he has experienced.

Gus joined Sandia in 1954 as a computer technician. He earned his BS in mathematics from High-

lands University in 1955, but didn't become a member of the technical staff until 1958, when he received his MS in physics from the University of Oklahoma.

He and a handful of colleagues had a striking success early on. "That success," says Gus, "bought me an indulgence. It bought for me a license to do interesting things."

Back in the late 50s, a handful of Sandians, led by former director Don Shuster, a division supervisor at that time, and others who have since gone on to successful careers at Sandia, worked on designing

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## Welber Testifies in Washington

### Don't Jeopardize National Labs

Late last month, President Irwin Welber testified before the Senate Judiciary Committee against the repeal of a 1984 law that required those claiming to have been injured by exposure to radiation during the atmospheric nuclear tests of the 50s to sue the government instead of the national weapons laboratories. Sandia and AT&T, as well as the other labs, are named as defendants in some of those claims.

In both written and oral testimony, Welber first made it clear that he does not oppose relief for veterans injured by exposure to radiation and that he is in no position to defend the decisions of the military services in regard to their placement of troops during the above-ground nuclear tests of the 50s.

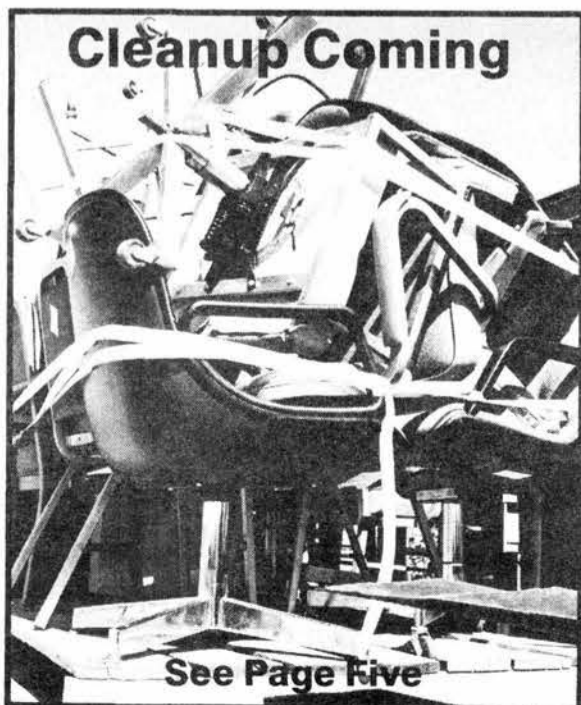
But he took a strong stand against the bill: Congress should not "place in jeopardy the scientific professionals who provided support for government tests, nor . . . put the corporate good citizen in the dock. The solution is to make administrative ave-

nues of relief work — and if these avenues do not work, they should be made to do so." He pointed out that various avenues are available to veterans under programs of the Veterans Administration and that it is Congress's responsibility to make those programs work.

Welber's main contention was that, although the national labs were heavily involved in implementing the atmospheric nuclear tests in the Pacific and at the Nevada Test Site, that involvement was limited to what he termed "scientific support functions." That is, the labs furnished a nuclear device; predicted its output; armed, fuzed, and fired it; and measured its effects on weapon components and other hardware — not on people.

Nuclear testing, Welber pointed out, has always been the direct responsibility of the U.S. government under "specific and exclusive statutory author-

(Continued on Page Four)





# Antojitos

**On the Happy Side** Like Gus Simmons, I wear a beard and live in the mountains in a house I keep working on year after year. (If you ever stop, you lose your Mountain Dwellers license.)

But there the similarities end. If Sandia has anyone deserving the "Renaissance Man" label, it's Gus. I (and many others around here) may know a little bit about lots of things. Gus knows a lot about damned near everything -- and his worldview is as coherent as a worldview can be and still be rational in a gloriously incoherent world.

What the twinkle in Gus's eye tells you is that he's still turned on by the intellectual challenge of it all, whether the topic is cryptology, parlor magic, origami, house construction, or any of his several other passions.

Part of that twinkle, I'm sure, comes from his knowing how his trademark, the long beard on one end of his head and the crew cut on the other, catches people's attention. (Not always approvingly -- an ex-Sandia president chided him over the course of several months about the beard and finally asked him, point blank, "You a Mennonite or something?" "Something," replied Gus, who at that moment decided the beard was well worth keeping; and, of course, he's become quite attached to it -- on the one end, at any rate.)

I congratulate Gus not only for his ability to deal with presidents but also for his earning the Lawrence Award (and I thank Ken Frazier, 3161, who, in spite of tight deadlines, wrote the stories describing the work underlying the award).

Way to go, Gus! You let us all bask in some reflected glory, however dimly it's -- in my case, at any rate -- reflected.

\* \* \*

**On the Sad Side** Sandia historian Necah Furman (3151A) called the other day to report that Ted Alexander had died, after a lengthy illness, on June 28 in Rocky Mount, NC. I never knew Ted, in spite of the four years we overlapped here in the late 60s. But I know his most famous work, "A History of Sandia Corporation through FY63." It's a fitting memorial, one that will live on in the minds of those who knew the spirit of the early Sandia, and in the Sandia histories yet to be written. Our sympathies to his son Bob (2544) and the rest of Ted's family.

OBH

\* \* \*

Homo semper aliud, Fortuna aliud cogitat. (Latin: Man always has one thing in mind, Fate another.) -- Publilius Syrus

## Chinese Scientist

### Visits Sandia

It's not often that citizens of the People's Republic of China visit Sandia, but that's exactly what happened several weeks ago. Fujia Yang, director of the institute of modern physics at Fudan University in Shanghai, stopped in for a day of information exchange with Labs researchers doing work similar to his on ion beam analysis and materials science.

Hosted by Barney Doyle (1111), Yang shared some of his organization's work at a solid-state science colloquium, then proceeded to tour some outside-the-tech-area labs where ion beam research is conducted. (Thrust of the work at Yang's institute is accelerator-based atomic physics.)

Besides his job as institute director, Yang is also dean of the graduate school and head of the nuclear physics lab at Fudan University. (Some 9800 undergraduates and 1400 graduate students attend the university.)

His predecessor as institute director -- a woman -- was elevated to university president in 1983, and that's when Yang moved into his present job. "The institute is very well equipped," he says, "and there's a good reason. Its former director is now president of the university!"

He was vice chairman of the department of nuclear science at Fudan University before the beginning of the "Cultural Revolution" in 1966. Like other scientists, he was *persona non grata* during the ten-year revolution, but resumed his former job in 1977 after the revolution ended. The next year he became chairman of the department, the job he held before becoming director of the institute of modern physics.

Yang's first visit to the U.S. was in 1978, though he's made frequent trips here since -- about one a year, he says. What's the thing that impresses him most about this country? No, it's not the large number of cars and the relatively few bicycles on the road. Rather, he says, "Your 'system' encourages people to work hard because they are rewarded according to their productivity, and how good they are at their jobs.

"The problem in China -- before reform began in 1978 -- was that our people did not have similar incentives," he continues. "Workers in the same jobs were paid the same, regardless of productivity and attitude. But the situation is gradually changing; recognition and reward are more and more dependent on a worker's contributions."

Another thing Yang notices about the U.S., in comparison to other Western countries, is that "People are in a hurry. They just don't move that fast in other places!"

In answer to another question, Yang reports that the ratio of women to men scientists in China is about 20/80, though in certain fields, e.g., chemistry, it's about 50/50. "There may be fewer women in the sciences," he says, "but the ones there are very, very good."

Yang was born in Shanghai, China's largest city (population: 11 million). He received both his undergraduate and PhD in physics from Fudan University, and was the first person from the Republic of China to be sent to a Western country for postdoctoral work. That was in 1963, when he enrolled at the Niels Bohr Institute in Copenhagen.

It was his first exposure to people from the West. He became acquainted with some 30 U.S. scientists during his two-year stay in Copenhagen. Interestingly enough, though U.S.-mainland China relations were very strained at the time, "The scientists had no difficulty in getting along," says Yang. "National boundaries tend to disappear in a place like the Bohr Institute."

Yang hosted Barney Doyle when he visited China a couple of years ago, so the two were glad to renew their acquaintance during Yang's visit here. One of his own hopes, the Chinese visitor says, is to continue developing further scientific cooperation between the two countries.

### ECP Committee Seeks Past Aid Recipients

Were you ever served directly by a United Way agency -- such as the American Cancer Society, Albuquerque Child Guidance Center, or the American Red Cross? Did aid from any United Way agencies have an impact, if only temporarily, on your life? Or, is there a particular agency in the Employee Contribution Plan (ECP) program that you fervently support?

If so, the ECP Committee would like to hear about it. Retirees, in particular, are requested to aid the upcoming publicity campaign by sharing their experiences. Please call Sharon Ball (3163) at 6-0348 by July 25.



FUJIA YANG, director of the institute of modern physics at Fudan University in Shanghai, People's Republic of China, recently visited Sandia for a scientific information exchange with Labs researchers. Here, host Barney Doyle (1111) looks like he's enjoying the discussion with Yang at the Van de Graaff accelerator in Bldg. 803. Yang's institute uses accelerators for materials science work.

#### No-Frills Computer

A product of Intec Inc. of Eugene, Oregon, ... the Generic Computer is touted as easy to use and fully portable, and it comes complete with word processing and color graphics. You get all this for a mere \$5.95, plus 75 cents for shipping and handling. What's the secret? This mostly cardboard put-on of personal computers has a pun-filled dictionary as its word processor, crayons for color graphics, a pencil for letter-quality printing, a Popsicle-type stick as its joystick, and a paper clip as its "data link."

Science Digest

## LAB NEWS

Published Fortnightly on Fridays

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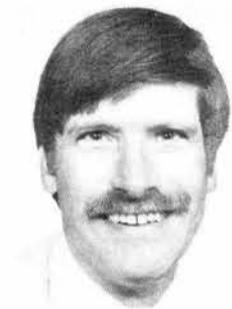
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## Two Telemetry Systems Designed for Peacekeeper



As part of its role in the W87 warhead development program, Sandia is responsible for the design of a telemetry system to monitor the Peacekeeper missile's performance during flight tests with the W87 aboard. (The W87 is just one of a number of simulated warheads from various agencies carried by the Peacekeeper, formerly the MX, missile.)

Both versions of the system have proven notably successful in recent tests. Ralph Clark of Flight Test Instrumentation Systems Division 8173, which has had the main design responsibility for the systems, describes the challenges involved in the project:

"First of all, our telemetry is an electronics package that fits into the warhead, which is located in the RV [reentry vehicle], which, in turn, is launched in the Peacekeeper missile. Because it replaces part of the physics package, the telemetry system has to be the same size as the parts it replaces, matching as closely as possible the weight of those parts — no easy trick."

Ralph's team designed two kinds of telemetry packages: The first, called MOD-2M, was for the first series of flight tests that used a lot of modified off-the-shelf parts. The second system (MOD-2) was specially designed, ordered, and built. It is capable of monitoring vibration and shock, electrical warhead functions, pitch and yaw, roll rate (vehicle dynamics), internal pressures and temperatures, displacements, and fuze data.

"The MOD-2 has 200 channels," says Ralph. "It also has a terminal data analyzer that provides the data needed to assess the performance of the simulated warhead. This telemetry system is state-of-the-art with multiple microprocessors and a sequencer that checks acceleration levels and electrical function data, then modifies the program in the microprocessors to compensate for any discrepancies."

Seven flight tests of the RV, conducted jointly by Sandia and the DoD, were successfully completed by March 7. The missiles were launched from Vandenberg AFB to various targets in the Pacific in the areas of Kwajalein and Guam.

A launch sequence begins when the missile is

ejected from a canister and ignites. It is during this before-and-during launch sequence that collecting data is most difficult because the telemetry package in the RV is shielded by a titanium shroud.

To overcome this data blackout, Ralph's team set up a secondary transmission link to receive data while the missile is still in the canister. The shroud is discarded during the boost phase of missile flight, approximately two minutes after launch. At this point transmission is switched to the RV antennas. This entire transmission sequence is powered by a battery in the RV.

"During flight, data are recorded at four dif-

ferent sites — Vandenberg telemetry receiving station, Pilar Point (south of San Francisco), Hawaii midrange receiving station, and Kwajalein — as well as in aircraft in the vicinity of the impact site.

"The data are pieced together at Livermore to make a continuous record of the entire flight," says Ralph. "We end up with a lot of tapes. But we've had a very good success rate — I might even call it phenomenal — with our instrumentation."

Others in the 8173 design group are Bob Peterson (supervisor), Les Jones, Doyle Baker, and Frank Bielecki. Ed Diemer and John Becker (both 8171) also assisted in the project.

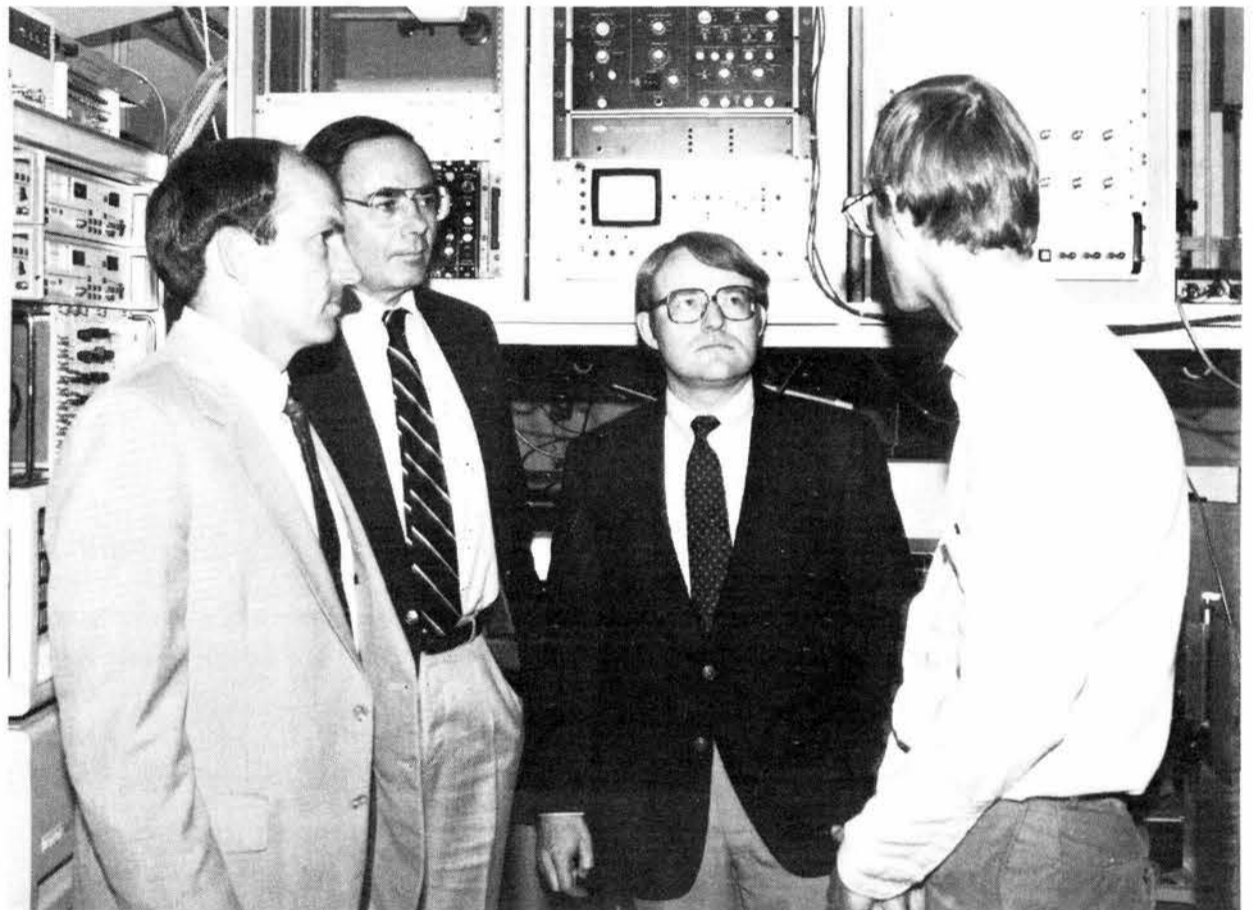


## SANDIA LIVERMORE NEWS

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GETTING A LOOK at the pyrogenic materials lab in the Combustion Research Facility during a recent visit to Sandia Livermore were John Bradburn (second from left), director of program liaison for the DOE Office of Congressional Affairs, and Tom Weimer (third from left), energy coordinator for the House Science and Technology Committee (and former Sandian). Showing them the experimental setup for probing a flame used to generate silicon dioxide for optical fibers was Mark Allendorf (8361) at right. Dan Hartley (8300) escorted the visitors.

## Take Note

Two Livermore Sandians recently received the Gold Medal Award from the American Electroplaters and Surface Finishers Society for the best paper published during 1985.

Joe Farmer and Rudy Johnson (both 8313) were given the award for their paper, "Application of Dynamic Impedance Measurements for Adsorbed Plating Additives," which was published in the *Plating and Surface Finishing* journal last year. They were honored at the annual technical conference of the society in Philadelphia June 23.

## Sympathy

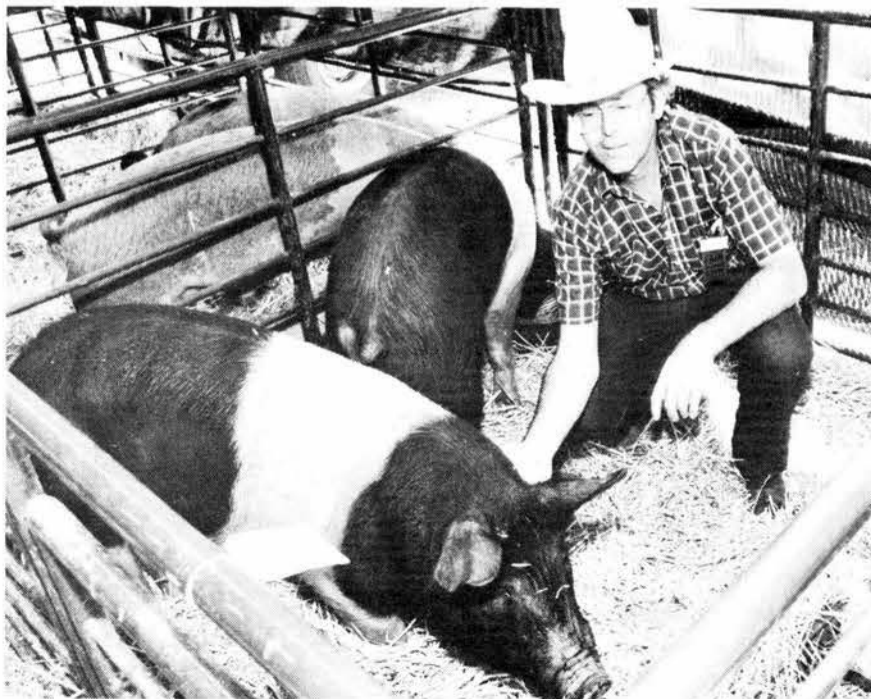
To Jerry Moore (8315) on the death of his father in Livermore, June 28.

To John Smith (8132) on the death of his mother in Stockton, June 28.

## Academic Perils of the Abacus



"Look around this department," says Stanford [Univ.] mathematician Joseph Keller. "We have fewer computers than any other department on campus — and that includes French literature." "It's a funny thing," says Robert Osserman, a colleague of Keller's. "The absence of computers is clearly a combination of conservatism on the part of mathematicians — their not wanting to take time out to really learn how to use the computer effectively — and a strong conviction that a lot of the time when you use a computer, it's just an excuse for not thinking harder." *Science Digest*



IF YOU DETECT the odor of bacon when you pass the CAD/CAM work station of Dick Finn (8272), it's because he spent much of two weeks ending July 6 at the Alameda County Fair. He wasn't just a spectator; he served as chairman of the 4-H swine exhibit and also judged the mechanical and architectural drawings of junior and senior high schoolers for the Education Division in the Young California Building. Dick is shown with two of his son Peter's Hamp-Duroc-Yorkshire crossed hogs. The one 247-pound porker he sold brought \$1.25 a pound (double the normal price) at the closing day auction of FFA and 4-H animals.



## Welber in Washington

ity." Tests were/are planned at the highest levels of the Atomic Energy Commission (then) or the DOE (now). And each test is authorized by the President of the U.S. It was, therefore, the government — not the labs — that "decided to place military personnel in those duty assignments upon which our veterans now base their claims. Sandia did not then, and does not now, direct any of the deployments or placements of members of the United States Armed Services.

"Now, veterans are presenting claims that exposures to nuclear weapons testing caused them serious health problems," Welber continued. "We have great sympathy and concern for these individuals; they are veterans for us all; they served us all when they served our country. And, while we do not know the merits of any individual claim, we share the concern of all citizens that those who feel that they can prove harm should be fairly and justly treated."

At the same time, Welber emphasized that fair and just treatment for the veterans should not mean putting Sandia and AT&T at risk by making them defendants in court suits brought by the veterans: "To expose the Sandia scientific community and AT&T to such trials would place in very serious jeopardy our special relationship — one which has been credited with creating a unique environment for scientific innovation. Indeed, we have been able to attract scientists and engineers with unique capabilities to pursue national defense goals with vigor and effectiveness. It would be most unfortunate if the result of this type of legislation were to be the withdrawal of the best and the brightest in the scientific community from the field of weapons technology.

"Likewise, our no-profit corporate sponsor, AT&T, faces regular challenges at its annual stockholders' meeting, where shareholders oppose the company's continued participation in this program. Withdrawal of that sponsorship would ill serve the nation."

New Mexico Senior Senator Pete Domenici testified at the same hearing. He too argued strongly against adoption of any new law that would repeal the law that now recognizes that the labs acted only as instruments of national policy and that the U.S. government is the only real party in interest: "It is simply unfair and unconscionable for the United States government to allow the national laboratories which assisted it in carrying out this [nuclear weapon testing] program to be held responsible for the consequences of the government's policies, decisions, and actions."

Don Ofte, Principal Deputy Assistant Secretary for Defense Programs, DOE (and formerly Deputy Manager, AL), also protested the bill: "The bills being considered today do violence . . . to the sense of fairness with which these contractors [the weapons labs] have a right to be treated, especially in light of their enormous contributions to this nation's security."

Harold Folley (4010) assisted Welber in preparing his testimony and attended the hearing.

### A Bit of Background

## The Role of Troops In Nuclear Tests

Over the years between 1945 and 1962, 212 nuclear tests were conducted in the atmosphere by the U.S. government. Of these, 112 were in the Pacific, and, of the 100 remaining, most took place at the Nevada Test Site.

According to the testimony of Richard Willard, Assistant Attorney General, Civil Division, Dept. of Justice, some 203,000 DoD people, mostly military, participated in atmospheric tests during the same period. At NTS, the troops were typically stationed at varying distances from ground zero, some in slit trenches as close as 10,000 yards (about 5.5 miles), says Dave Miller, public info officer at DOE's Nevada Operations Office.

The rationale for the troops' presence was apparently psychological — how well could front-line troops operate their weapons or follow orders after witnessing the awesome sight of a nuclear detonation? Don Ofte's (DOE) testimony before the Senate committee confirms that assumption — the rationale was "to examine a person's continued fighting capability in a battlefield environment that includes nuclear weapons."

At any rate, the rationale wasn't physiological; the troops were not used as guinea pigs. For the physiological effects were minimal. According to a study by the National Research Council, the vast majority of the troops (about 99 percent) were exposed to a lower radiation dose than they would have received from natural and medical sources over the same period of time.

### Why the Switch?

## How Sandia Found Its Corporate Parent



Harry Truman's urging of Sandia to render an "exceptional service in the national interest" — the theme of this year's Family Day — worked. And in the end, it transformed not only the face but the skeleton of the Labs.

Several factors prompted the change in 1949 from academic to industrial management of Sandia. Those included physical proximity to Los Alamos, logistics (potential for ready access to a full-size airport in Albuquerque), and the University of California Regents' feelings that it was inappropriate for the university to be associated with weapons production and engineering during peacetime.

AT&T (American Telephone & Telegraph) was chosen to direct the Lab in 1949 because the Atomic Energy Commission (AEC) "decided that the AT&T organizations possessed characteristics which would enable them to provide the most suitable operation of the Sandia project" (memo from Brig. Gen. James McCormack Jr., Oct. 4, 1949).

More specifically, according to historian Neeah Furman (3151), AT&T, with its manufacturing subsidiary (Western Electric), and Bell Telephone Laboratories, with its research capabilities, offered the broad experience base necessary to support the Sandia operation. Sandia, at the time, was involved basically in applied research and the manufacturing of components and case parts. Therefore, the industrial complex selected had to be capable of starting with research, carrying through development, and continuing with prototype production. The Bell System offered this combination.

The official change in management took place on Nov. 1, 1949. A press release issued two months earlier explained to the public a part of the rationale for the transfer: the growth of the lab. What the press release didn't mention, however, was that the AEC had recognized Sandia — and then Sandia Corporation — as an integral part of the defense complex and had an overriding desire to ensure its continued success.

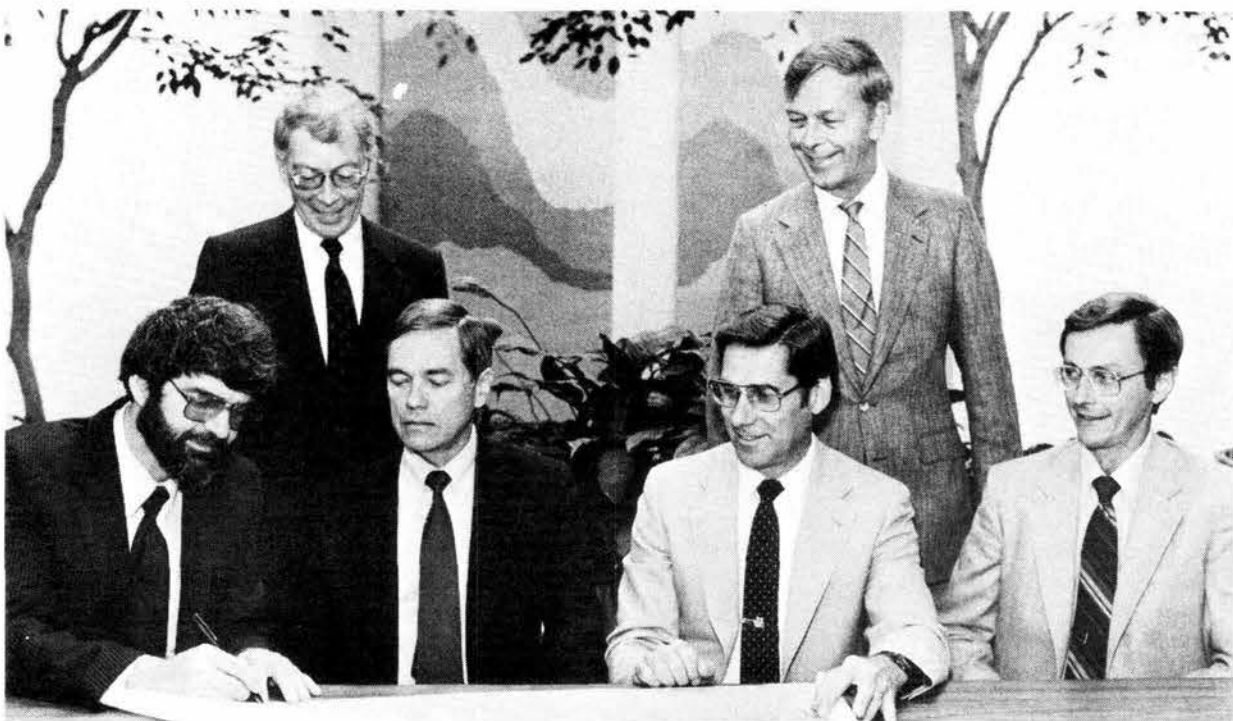
The switchover meant that the services and facilities of Western Electric, Bell Labs, and other Bell System companies were available to Sandia. The first president, George Landry, was a Western Electric import with a background in manufacturing engineering. Along with Landry came others from Bell to fill positions in top management. By 1952 there were approximately 25 Bell System employees on roll at "The Corporation," as it was known in the local area. (Today there are 32, with most in upper management.)

### History of a Head of Beer



Life history of an aqueous foam is completed in less than an hour for the foamy head on a glass of beer. The foam is formed when the carbon dioxide dissolved in the beer returns to the gaseous state, yielding bubbles separated from one another by films of the watery liquid. At first the films are thick, the foam's content of liquid is great, and the level of beer is correspondingly low. Like all other foams, however, the head is only metastable, or temporarily persistent: Its films give it great surface area, which is thermodynamically unfavorable. Moreover, gravity draws liquid from the foam. If no other destabilizing influences came into play, the films might drain to a thickness at which they were stabilized against further thinning by electrical and chemical forces. In addition, the molecules in very thin films can orient themselves in arrays that cannot be disassembled without an expenditure of energy . . . Meanwhile water is evaporating. The foam coarsens, and eventually it collapses.

— Peter Rand, James Aubert (both 1813) and Andrew Kraynik (1511), in *Scientific American*



REPRESENTATIVES of the three design agencies for the Trident II program — Sandia, LANL, and Lockheed-Sunnyvale — met at the Labs recently to sign interface control documents for the program, which began in March 1984. The documents indicate agreement that no future Trident II design changes can be made without formal concurrence by the three agencies and the Navy. Adding his signature (left) is Dave Ponton, LANL Trident II program manager. Looking on are (l to r, front row) Bill Nickell (5151), responsible for AF&F development for Trident II; Sam Jeffers, responsible for Sandia warhead development for Trident II; and Roger Teter, Lockheed-Sunnyvale manager for reentry systems design. In back are Dan Hardin (5150, left), Sandia Trident II program manager; and Bob Carlson, Lockheed-Sunnyvale manager for reentry systems.



# Thou Shalt Be Clean

Noticed some dirty fingernails lately? Seen more jeans than usual? The first deadline on site cleanup at SNLA is today, for part of the 3000 organization. Right upon its heels are July deadlines for parts of 7000 and 6000.

The cleanup campaign — an adjunct activity to official preparations for Family Day — will sweep geographically through the rest of Sandia Albuquerque

**Wash you, make you clean.**

— Isaiah. I. 16

que, inside and outside "The Fence," during the next three months. (Livermore had its own, highly successful, "Trashbusters" campaign last year.)

It's serious. The goal is clear enough: freedom from dirt, dust, and debris. The expected results: floor space gained, \$\$\$ saved, and safety improved — and what's most important, eyesores eliminated. Yes, folks, the purgative is near. It's time to despumate, lixiviate, and edulcorate. (It's all legal.)

And now scurfiness, phthiriasis, and scoriae are slated to go the way of the dinosaurs. A 12-

**If dirt was trumps, what hands you would hold!**

— Lamb, in *Lamb's Suppers*

section geographical strategy has been devised to get everyone involved in clearing out any junk stored around the site and in laboratories, offices, and corridors. Items previously termed "miscellaneous" or mislabeled as "doorstops" prequalify as junk. That includes unneeded paper, chemicals, supplies, equipment, furniture, and, of course, all UFOs (unidentified fermenting objects).

Each of the SNLA vice-presidencies has designated a cleanup coordinator who has full responsibility for calling a spade "a piece of garbage," and for scheduling and implementing the removal of any excess or obsolete materials. A list of organization coordinators is maintained by Frank Keene (7000), who's reachable at 6-4912.

The tactics for reclamation, storage, and dumping are spelled out on a cleanup check list compiled by Don Schubeck (3412) that is being circulated within the 12 sections (including Tech Areas I-V and CRTF). The list contains telephone numbers for assistance, standard form numbers, and excerpts from pertinent SLIs.

However, the style of the individual operations is basically free-form and will be defined further

**All will come out in the washing.**

— Cervantes, in *Don Quixote*

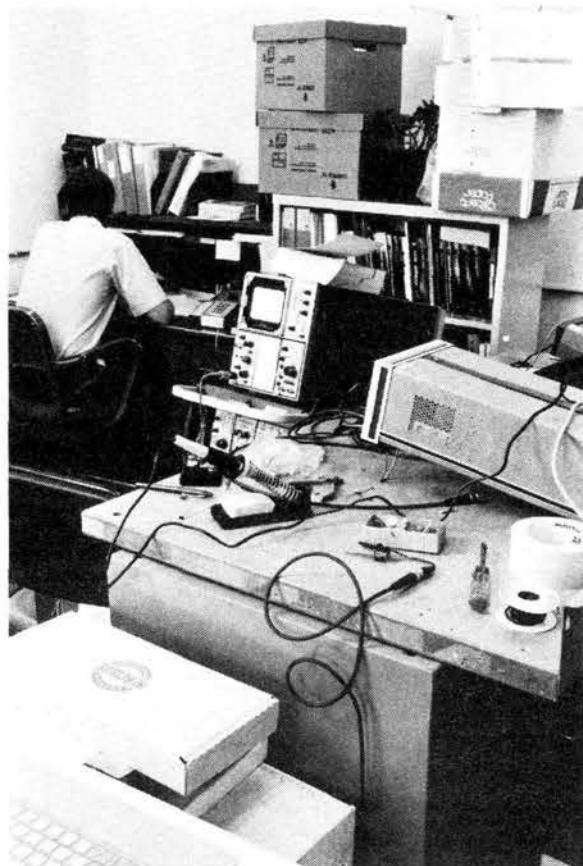
down the line by facility coordinators — a contact person in each building (more than one in larger buildings).

No dispensations are planned for Sandians away on vacation; before they depart, they too are obligated to do some paleontological digging and sorting of office strata into throwaways, giveaways, and savers.

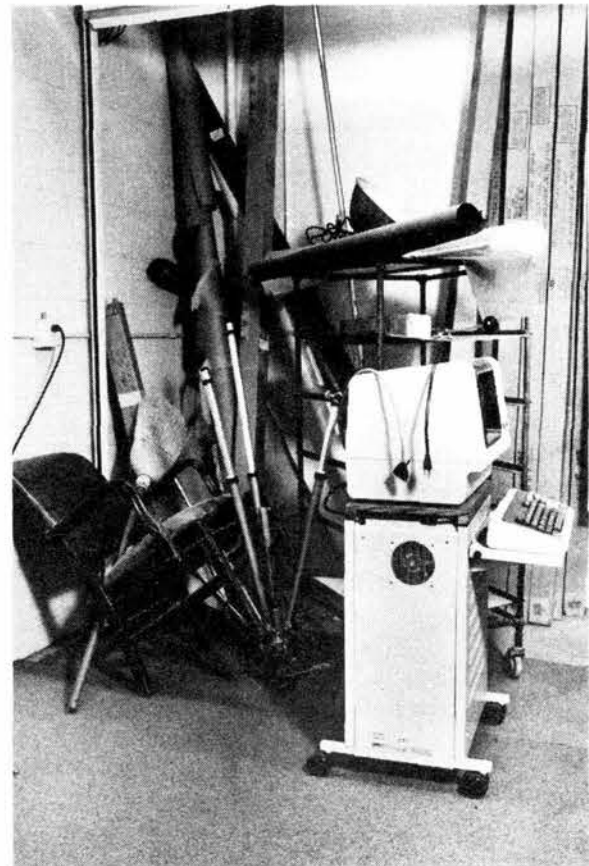
The improvised theme of "Don't just stand there and look at it, move it!" is destined not to be just a one-time hit, but to become a refrain at Sandia. Bob Peurifoy (7000) has announced a continuous cleanup schedule for 1987: one section each month, starting with section one in January.



HOWDYA SORT ALL THIS STUFF? Jim Martin (3400), site cleanup coordinator for Section I, uses body language to convey the main problem facing Sandians during the cleanup campaign. The crux of the matter is decision making. Everyone's help is needed identifying trash vs. treasures and then in notifying the proper organization — Reclamation, Office Furniture, Office Machines, Transportation, Grounds Support, Custodian, Environmental Health, Storage, and/or Explosives — so pickup can be arranged.



RUBE GOLDBERG, give up! The mousetrap may be getting bigger but it doesn't look better. At least the boxes are all there for carting the extras away. . . All you have to do is fill out a form.



NO ROOM UNDER THE RUG. . . or in the corner. Some of that equipment's simply gotta go out the door. Our roving photographers caught this room pretty close to home.



MEA CULPA; we're all culpable, even in the LAB NEWS. Those piles and stacks of items, more or less filed around the fridge as J for "junk," G for "garbage," and E for "et cetera," all have to go.



BOTH UNCLEARED AND CLEARED Sandians have a task on their hands: to make a clean sweep of offices and laboratories. The targets are long-unused furniture and equipment.



## Two-Level-Metal Microchip: Bridge to a New Generation

Sandia's fabrication of a radiation-hardened memory chip with two levels of metal interconnections — each two microns wide, narrower than a blood cell — makes possible a whole new generation of microprocessors.

The promise stems from providing "another degree of freedom for designers," says Tom Hill (2132). "They will now be able to work with much shorter and straighter metal runs — which decrease electrical resistance — and to pack in more components." At the last count, the total was more than 100,000 transistors interconnected in a single silicon chip.

Traditional chips are one-level. The new system of adding another level of interconnections can be compared structurally to making a two-story shopping mall out of a flea market.

In the case of the two-level chip, however, the parts are microminiaturized. The component dimensions in the thumbnail-size prototype (produced late last year) are already at the lower limits of viewing with an optical microscope. Yet, scaling down of all feature sizes in chips — particularly for space applications — is a continuing goal at the Labs.

"The packing density and the performance of the parts are what make two levels worthwhile," says Tom. "In essence, you can increase the speed of the parts by 30 percent. We've been able to reach 85 billionths of a second in read-access time," i.e., the speed it takes to put in a signal and get data out.

Tom's job is to build this chip by combining several new processes. "We took what we had at Sandia — a one-level, radiation-hard chip — and built on it," he says. The fabrication sequence now totals 280 steps.

### Four More Coups

Four technical coups are particularly significant. They are shared by Sandians working under the direction of Bob Gregory (2100) at the Center for Radiation-Hardened Microelectronics (CRM).

The first coup involved an initial stroke of good luck for Bruce Draper (2132), who heads the metalization part of the project. That was the use of tantalum silicide as a new first-level material. "It just happened to be in place from another process for testing," says Tom. "If it hadn't been there, we might not have found anything as good for a year."

So now a submicron layer of tantalum silicide — as thin as a virus — caps the first-level aluminum. Although pure aluminum has very good conductivity and adherence to silicon insulation, it is prone to forming hillocks, or lumps, at relatively low temperatures. "Tantalum silicide is very stable and



THE GOOD-CHIP LOLLIPOP, a four-inch wafer held with tweezers by Elaine Buck (2132) in the clean room, actually contains both working chips (lighter colors on the grid) and test dies (darker shades). Cleanroom attire — a nurse's cap, mask, safety glasses, acid-resistant jumpsuit, and surgeon's gloves — is worn "more for the wafers' protection than for ours," says Elaine, process science engineer in thin films.

prevents this hillock formation, so the odds of causing electrical shorts are substantially reduced," says Tom.

The second feat was Tom's: a film deposition technique that works at low temperatures, essential for preserving radiation hardness. The plasma-assisted procedure deposits silicon dioxide ( $\text{SiO}_2$ ) over the contours of the aluminum/tantalum silicide layer.

The third coup is credited to Bruce Bell (2131). Called planarization, the new method forms a thin insulating layer between the two metal lines. Photoresist is spun on, in liquid form, to create an almost flat surface. Plasma etching — with ions bombarding the surface — through the photoresist and the  $\text{SiO}_2$  layers allows very fine resolution. The final depth of etching can be controlled to within 1000

Angstroms — equivalent to the space between nerve cells.

The fourth coup, in Ray Patteson's (2131) lithographic domain, is the etching of vias, or contact holes, that allow current to flow through the chip's insulation between the two levels of metal. Currently all the vias are wider at the second-level end to help lay down aluminum so that it covers what would otherwise be a right-angle step. The sloped via prevents thin, uneven metal on the sidewalls (that could build up high resistance and heat in the aluminum contacts). This step-coverage problem may be licked in the future by adding tungsten to the bottom of the vias. Preliminary tests at Sandia have shown that tungsten would fill deep, narrow vias more uniformly (see LAB NEWS, Nov. 22, 1985).

Each of CRM's four process improvements has contributed heavily to the advanced chip design, and is bound to spur more refinements over the next few years as the two-level chip continues to be tested against Sandia's rising rad-hard standards.

### Quality Control

Achieving quality control at these minuscule sizes isn't easy. "There are a lot of visual inspections with optical and scanning electron microscopes during processing of the 25-wafer lots [each wafer has 200+ chips]," says Tom. "Then critical dimensions [line width, for example] are routinely measured."

Weak parts are screened out after fabrication. This is done by stressing the parts with temperature and voltage, resulting in some "infant mortality" of parts that could otherwise fail in their youth.

"We're already making functional parts, and I'm pretty sure that the process flow will be in place this year," says Tom. "I have a pretty good feeling about it."

The next step is to take advantage of the extra space created by the two-level process to incorporate more protective features against radiation damage. The threat to microelectronics in satellite applications is that high-energy particles known as cosmic rays may hit a junction region in the silicon and release electrical charge. That can couple transistors in an unwanted pattern and make a bit go bad. Preventing memory loss, temporary or permanent, in the chip is obviously desirable.

"Preliminary testing has shown that we have met the specs on total dose of radiation hardness — 200,000 rads — for our satellite programs," says Tom. "But our goal is significantly higher: to meet a 1-million — or even 10-million — rad-hard standard."

## Commuter Notes

The rains stopped long enough to hold the Transportation Fair outside on July 8. Nearly 200 people stopped by to look, and 127 people requested information on commuting alternatives. Areas of interest (starting with most popular) were: bus, bicycle, carpool, computer driving analysis, and vanpooling.

Winners of the prizes were: monthly bus passes (worth \$19) — William Morgan (7475), John Lanoue (7472), Kenyon Nowotny (2645), Manjit Ahluwalia (132), and Bill Stocum (3311). Gift certificates at Rain Tunnel carwash (worth \$10) — Max Marrs (2601), Chris Padilla (2831), William Frix (5347), Dru Summey (3426), and Don Schubeck (3422). Lunch coupons at Sandia Cafeteria (worth \$3.50) — Sidney McAhren (6412), Elizama Espinoza (7543),

Ida Horn (2334), Ronald Hellmer (1154), and Don Gatto (3422).

If you're one of those who don't need a transportation fair to interest you in other ways to get to work, call Commuter Coordinator June Aydelotte (3543) on 4-RIDE.

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The Rio Rancho/Corrales vanpool has revised its route. It now originates in Rio Rancho and picks up Corrales folks at the Corrales Shopping Center. If you would like information about joining the vanpool, call Nick Durand (2512) on 892-4013 or June on 4-RIDE.

### Welcome

Ohio

Daniel Nelson (7123)

Texas

Yvonne Krause (7524)

## Congratulations

Kim Darby and Mark Garrett (7535), married in Albuquerque, May 31.

Patty and Roger (1112) Shrouf, a daughter, Kelly Leann, June 2.

Karen Galloway and Mark (7243) Brenner, married in Albuquerque, June 7.

Ginger (6431) and Jim Wilkinson, a son, Jeffery Shane, June 13.

Shirley Shaw (7861) and Keith Mayer, married in Albuquerque, June 14.

Sue Glor (7831) and Roy Ricci, married in Albuquerque, June 21.

Nancy and Graham (7473) Yelton, a son, Eric Shawn, June 26.

Theresa Romero (5311) and Paul Apodaca (3154), married in Belen, June 28.

Nancy (SLFCU) and Joe (2624) Schofield, a daughter, Amanda Nicole, June 29.

Mary and Scott (343) Strong, a daughter, Laura Elizabeth, July 8.

### Better to Wear Out Than to Oxidize



While the outward signs of human aging are all-too-apparent, what's going on at the cellular level is more obscure. Researchers now propose that oxidation processes are one cause of cellular aging. Put less prosaically, we may all be rusting.

Science News



## Retiree Met Celebrities During World War II

Charles Lindbergh and Jack Benny couldn't have had much in common: at least that's what most of us assume. But LAB NEWS learned recently of at least one link. Sandia retiree Hal Vaughn met both of them while serving in the Pacific Theater during WWII.

Hal, who was a fighter pilot assigned to the Army Air Corps' 40th Fighter Squadron, 35th Group, moved around from island to island in the South Pacific from the time he arrived there in June 1944 until the end of the war.

"It was late 1944," recalls Hal, "and I was stationed on the island of Morotai, some 600 miles south of the Philippines. My squadron was flying missions about every other day — some escort duty [of ships, bombers, and transport planes], some fighter sweeps [against enemy planes and ground targets]. At that point we were flying P-47s — one-man fighter planes — that had a maximum combat radius of 700 miles.

"One day Charles Lindbergh arrived — via transport and without fanfare — on the island. Turns out he'd been working with Republic, the P-47 manufacturer, on ways to increase the maximum combat range of the plane. So he was sent as a military advisor to work with my squadron on ways to get those P-47s flying farther during missions. We [the squadron] seemed to be an experimental group who tried new things first; that may be the reason he was sent there, rather than someplace else."

Lindbergh's suggestions on how to increase the P-47's maximum range from 700 miles to 850 miles were fairly simple and did the job, says Hal. "We were to use constant throttle, and use the pitch of the plane's propellers to stay in formation," he says. "And we were to throttle way back to 190 mph — felt like you were flying in slow motion. But it worked, and from then on we were able to fly 850-mile missions. We used the same techniques on P-51s when we switched to them from P-47s in early 1945; combat range improved with the P-51s, also."

What about Lindbergh, the man? Was he really as aloof and standoffish as reported by the press? "That description is right on target, as far as I'm concerned," says Hal. "Naturally enough, I didn't expect I'd be hobnobbing with the guy; there are some rank barriers in the military — first lieutenants don't spend a lot of time with colonels!

"But we did all eat in the mess hall together. Occasionally, when I'd be sitting across from Lindbergh, I'd try to make some kind of conversation. More often than not, he wouldn't answer, *unless* the comment or question had to do with flying. Then *sometimes* he responded. All of us soon learned that the guy was single-minded; flying was his life."

Lindbergh truly was a "lone eagle" during his three-week stay on Morotai, reports Hal. He shied away from conversations with anyone when the talk even brushed or came close to personal topics. The squadron commander, with whom Lindbergh stayed while on the island, reported after he left that the famed aviator had talked very little, even though the two were together most of the time.

"We all had the feeling that the guy had been hounded by the media and the public for so long that he had turned inward," says Hal. "You can begin to understand that attitude if you think about all the



HAL VAUGHN (right) and his crew chief throughout WWII stand in front of Hal's P-51, "Bucko," at Clark Field outside of Manila in 1945. Hal flew P-47s until early 1945, when he switched to P-51s.

publicity and attention that followed his solo transatlantic flight in 1927, the kidnapping and murder of his son in 1932, and the criticism he received in the late '30s when he advocated U.S. neutrality in a European war.

"Lindbergh wasn't liked or disliked [by squadron members]," continues Hal, "because there just wasn't that much interaction. He was pretty much of a recluse. At the same time, all of us recognized the risks that he'd taken when he flew in by transport to help us, and we respected him for that. His risks didn't stop there, either; he flew several combat missions in the Pacific during the war."

### And What About Jack Benny?

In July 1945 Hal, stationed in New Guinea, was flying combat missions and serving as a combat tactics instructor. One day, after a particularly grueling mission, he learned upon his return to the base that Jack Benny and several Hollywood starlets were appearing at the O-Club that night. Instructors were supposed to show up.

"You can imagine my reaction to the 'command performance' bit," says Hal. "I was dead tired, and all I really wanted to do was hit the sack. But I wandered up to the O-Club about 8 o'clock. O-Club, by the way, was kind of a highfalutin' name, since it was nothing but a two-room grass shack. The Hollywood ladies — I don't remember who they were — were in the room that had a piano, and they were dancing with some of the guys.

"Jack Benny was in the other room — it was furnished, as I recall, with a couch, a chair, and a lamp. He was talking with one of the other pilots, who, when he saw me, saw his chance to leave and did exactly that. I sat down, we started to talk, and the next thing I knew it was nearly 1 a.m.

"Benny was an extremely bright guy — and a fascinating conversationalist. I guess that's obvious; conversations with *anyone*, let alone with strangers, don't usually last four or five hours! In person, he was just the opposite of the character he portrayed on stage — that stingy, forever-39, violin-playing guy with the put-down sense of humor. Instead, he was serious, articulate, and very knowledgeable about what was going on in the world."

What did they talk about? "Everything — you name it," says Hal. Benny wanted to know what it was like to be a fighter pilot, how the war was going. In turn, he told Hal how things were back in the U.S. and in other places in the world he'd visited while

on one tour or another.

Did Hal get the idea that Benny perhaps slightly envied Hal's fighter-pilot status — his opportunity to be in the thick of things? (When celebrities such as Benny entertained the troops, the shows were presented in fringe areas far removed from the action



OUT-OF-UNIFORM Hal Vaughn poses in a P-47 while stationed at Okinawa during WWII. Charles Lindbergh helped Hal and his squadron increase the combat range of the P-47 from 700 miles to 850 miles.

and considered less dangerous for performers, Hal reminisces.)

"I can't really answer that question," says Hal. "But I do know that he [Benny] would not have been a good fighter pilot; he had too soft a heart. Fighter pilots are extremely aggressive; they must have tremendous confidence and the ability to make life-or-death instant decisions. They have to be able to walk away afterwards without remorse. Benny's compassion for people would not have allowed him to operate that way."

Hal never saw Jack Benny again after that conversation in a grass shack on a hot summer night in New Guinea. But the experience is a war souvenir he'll always treasure.

(Ed. Note: Hal retired last March after almost 35 years of service. He was supervisor of Aeroballistics Division 1631 before he left the Labs. He flew his last WWII mission over southern Japan the last day of the war — Aug. 14, 1945.)

HAL (second from left) and some of his squadron buddies lined up for a picture in front of a P-51 at Clark Field, the Philippines, in 1945.





## Success Bought a License

the first of the surveillance satellites, the Vela Hotel series.

"You realize that this was before microelectronics," says Gus. "The only electronics we had in 1958 was based on discrete components. Transistors were still a relatively new thing. They existed but they were still a new technology. And we were planning to fly something like an IBM computer in complexity. We had to do signal analysis in space.

"That had never been done before. It was unthinkable. Truly unthinkable. So a handful of us spent an entire summer shuttling back and forth to Washington devising arguments and rationales to try to convince people that, one, it was feasible to build something as complex as this, and two, that it would last long enough to have some useful life. It was a hard battle, because no one had ever built a micro-miniature computer, which is what we were proposing to do, much less launched it into orbit.

"I was in the very fortunate position of being in on the project at the beginning and of doing the original logic design. Many of the people involved are still here at Sandia.

"As it turned out we were absolutely right. Well, we weren't absolutely right, but we were more right than even we realized. We estimated that we should have a 'mean time to failure' in orbit of three months — that is, a 50-50 chance of operating that long. In fact the first Vela satellite lasted several years. Toward the end it was a nuisance because we had made no provision for turning it off. We didn't expect it to last that long."

The success of the Vela satellite program is what Gus says bought him "an indulgence" at Sandia. "What it actually did was it secured for me the license to go and do interesting things. I was very fortunate in that respect, and I credit that to Don Shuster. The success of the Vela Hotel program was pivotal to my career at Sandia."

This was the first of four milestones Gus says stand out in his career at Sandia.

The second was the "early work" on command and control. In the early 60s, after reading the report of an inspection of European weapon sites by the Congress's Joint Committee on Atomic Energy, then-President Kennedy and his science advisor Je-

rome Wiesner decided that the weapons in Europe were not under positive control as required by law. In a landmark National Security Action Memorandum, they ordered the AEC (Atomic Energy Commission) to correct the problem. This was the beginning of the PAL (Permissive Action Link) program, which put Sandia in the command and control business, notes Gus.

"I was lucky enough to be in Don Cotter's group at a time when that responsibility was being handled from a systems studies standpoint primarily out of his organization," he says. Not long afterwards Gus was offered a promotion to head a division responsible for "blackhatting" the PAL designs, i.e., to find ways to defeat them. It also included all of Sandia's nuclear safety activity, the early EMP (electromagnetic pulse) program, and parts of the AMAC (aircraft monitor and control) project responsibility.

"It was a huge division," and the subject was "hot and exciting," says Gus. "You can't imagine how exciting it was in the first couple of years of the 1960s in the command and control area. Everything was new, and we were trying to do things that at first appeared impossible. But it was all new technology, all new ideas. It was a period of tremendous intellectual ferment."

But in order to accept that new position, Gus reluctantly had to delay for years his work toward his PhD. (He returned to it in 1967 on Sandia's new doctoral studies program, receiving his doctorate from UNM in 1969 at the age of 39). "My career is backwards in a funny sort of way," laughs Gus. "I am doing the kind of research now — in my 50s — that people normally do in their 30s soon after completing their education, and I did my work on systems and applications at the beginning of my career."

What Gus considers his third milestone was a bit of a detour, unrelated to his work on command and control before or after. Yet, he says he's just as proud of it as anything he has ever done at Sandia. This was the design for NASA of a Mars probe for what would have been the first post-Viking mission to Mars (it fell victim to a NASA policy change to deemphasize planetary missions in favor of the space shuttle). In a proposed mission much less expensive than the Viking landings in 1976 and much more



GUS SIMMONS in 1964

productive than mere surface impacts, instrumented penetrators would have been ejected from a Mars-orbiting spacecraft to plunge beneath the surface of the planet, recording and telemetering data for about 400 days.

"It was really a unique marriage of Sandia technologies — terradynamics, high-G electronics that we had developed in our weapons program, telemetry capabilities, our nuclear-isotope power-supply technologies," he recalls. "It brought together a number of things that were unique to Sandia, and it was a beautifully logical concept. It was neither a hard lander nor a soft lander. This offered the possibility of having a cheap mission that was scientifically almost as desirable as a soft lander.

"I really regret the program didn't ever get to fly."

The fourth milestone has been the work on cryptography.

"For several years we had been deeply involved in studies of command and control, which is a cryptographic system," recalls Gus. "That was recognized, of course, at the outset. NSA [National Security Agency] has worked with Sandia in developing the PAL materials from the very beginning. But at Sandia we didn't have much to do with the cryptographic aspects. We were concerned primarily with the equipment, its security, and so on.

"It was fairly late in the game that we recognized that there were cryptographic questions in connection with the PAL program that fell between the responsibilities of the three principals [NSA, Sandia, and the military].

"What we discovered in the early 70s here in this department through mathematical analysis of the PAL algorithms was that decisions that had been made in one area for what appeared to be sound, logical reasons were having impact in other areas — serious impacts — that had gone unnoticed. And so in the 70s we got more and more heavily involved in the mathematical analysis of the PAL control system and discovered some really surprising and significant results — things that changed the way PAL locks were used, that changed procedures with which weapons were addressed. That's a matter of record now.

"What we were gradually doing, almost unintentionally, was getting involved in the cryptanalysis of the PAL-code management system. We didn't set out to be cryptographers or cryptanalysts, but we were soon deep into that type of analysis. The dividends were substantial.

"So, starting in the mid- to late-70s, prompted in part by the problem of verifying the authenticity of signals from unattended seismic observatories [the National Seismic Stations], we began to deliberately investigate questions of authenticity of digital mes-

## Simmons on Sandia Attitude, Latitude

With his distinctive long beard in a land of clean-shaven engineers, Gus Simmons (1964) would seem to be at home in a university math department as much as a government-funded industrial laboratory. But he says he wouldn't, and that goes to the heart of what makes Sandia special.

"I would not fit in at a university math department," states Gus. "That I know with certainty. I would not be comfortable, and I certainly wouldn't be nearly as productive in a university environment. What would be missing is this source of constant stimulation, the questions that come up in other areas and groups at Sandia. That stimulation is why we've been able to do good things.

"And they come to us from all over the laboratory. We've had such questions from the satellite program, from the site-surveillance program, from the area of monitoring a comprehensive test-ban treaty, I could go on and on down the list. What I would miss at a university — because it doesn't exist there — is this constant stimulus, from areas that are not mathematical themselves, of questions that in many cases have very substantial mathematical content.

"In the absence of the stimulus of real-world questions, the mathematics gradually spins itself down, in my opinion, and becomes less exciting to the person doing the work and becomes less and less applicable. I depend on that constant stimulation."

And Gus again expresses praise for the way

Sandia lets promising people pursue certain tasks. It wasn't at all clear at the beginning, for example, that Sandia should get involved in cryptography. In fact, good reasons existed for not doing so; the National Security Agency by executive order was already responsible for cryptography.

"The indulgence was the latitude I was given by management; at first by Tom Burford, and later by Orval Jones, John Galt, Don Shuster — a variety of directors — to pursue what I thought was right, what I believed wholeheartedly was a profitable line of investigation," says Gus.

"But there was a long period before that paid dividends for Sandia and the country. Now the payoff is great. We have more than a dozen programs at Sandia that depend on cryptography for their successful resolution. There were several years of work that preceded this when it wasn't clear that we were right. The indulgence was that management allowed the latitude to pursue a long shot. They were willing to gamble the time of all the people who worked with me that my instinct was right.

"The important attribute of Sandia's management was that I never felt — and I don't think the other people I've seen work in this way ever felt — that they were risking their career by taking advantage of this latitude that management allowed." If things hadn't worked out, he concludes, "I don't think it would have been held against me."



## Other 1986 Lawrence Award Winners

Five other members of DOE laboratories also received Lawrence Awards this year. The list and DOE's descriptions of the work for which they were recognized follow:

James Duderstadt (University of Michigan), a nuclear engineer, was selected for outstanding contributions to analysis of the movement of nuclear particles and radiation with applications to a variety of problems in both nuclear fission and fusion. He was also cited for his extraordinary contributions as a teacher, an author of textbooks, and a thesis advisor and counselor of graduate students in nuclear engineering and nuclear science.

Helen Edwards (Fermi National Accelerator Laboratory), an accelerator physicist, was cited for her leadership in the construction and commissioning of the Tevatron at Fermilab. This is the first successful superconducting proton accelerator ever built, and is now the world's highest-energy particle collider.

Joe Gray (Lawrence Livermore National Lab-

oratory), a biomedical scientist, was recognized for his exceptional multidisciplinary contributions to flow cytometry, the analysis of cell genetics and cell kinetics.

Bradley Moore (Lawrence Berkeley Laboratory and UC Berkeley), a chemist, will receive his award for his pioneering application of lasers to the investigation of isotope separation and chemical and physical molecular dynamics. These outstanding achievements have stimulated a revolution in experiments that employ lasers to elucidate fundamental energy capture, transfer, and release in molecular systems.

James Smith (Los Alamos National Laboratory), a physical metallurgist, will receive his award for establishing the fundamental significance of heavy fermion metals and their unusual electronic and magnetic properties, through path-breaking experiments and the discovery of new materials.

*Continued from Page Eight*

## License To Do Interesting Things

sages. We also began to correctly view the PAL-code management system as fundamentally an authentication system. What we were really doing in the PAL system was providing a very high degree of confidence that a message, something that was going to result in a weapon's being enabled, was an authen-

### From Gus — Thanks!

"I realize that often when people get an award they make the expected statement that this award is really given for the work of a lot of people and they just happen to be the one getting it," says Gus Simmons. "But in this case it's true."

He says it's true with him more so than in other cases because, ever since the beginning of work with command and control in the early 1960s, he has worked with and had the support of "some of the best and most creative minds I have ever known at Sandia." He says he is referring both to technical people working on devices and on ways to use them and to members of management — who in many cases have been involved in the hands-on work.

"I think of people like Jack Howard, who was a senior executive throughout this period but who took a personal hand in the command and control work. He was deeply involved. It was almost as though two staff members were sitting and talking about these issues when you dealt with Jack in the days when command and control was shaping up. The same was true for Leon Smith, Don Cotter, and Pat Patterson.

"These people were in varying levels of senior positions from department managers to vice presidents. But it wasn't as though they were directing the programs; it was as though they were full-fledged participants. The collaboration ranges from people in those positions to the engineers and technicians that I worked with in the actual designing and counterdesigning of systems and hardware."

Gus would like to name everyone who has helped him. But he says the list would be far too long and there is a danger of accidentally leaving out the name of a person who belonged there as much as anyone else.

"I recognize and would like to say, again, that I'm the beneficiary of the combined work of many of the most creative people I've known in my more than 30 years at Sandia."

tic command, that it came from the appropriate level of command, that it hadn't been tampered with, and furthermore that it couldn't be. And so by the late 70s we had a clear appreciation that there was a new type of problem in the area of secure communications — the authentication of digital messages, as opposed to secrecy, which is what cryptography traditionally provides. That was a big insight. That was a eureka."

When in 1976 two scientists at Stanford issued the first public report of two-key, or public key, cryptography, Gus says it became "absolutely transparent that there were two channels involved, a secrecy channel and an authentication channel." In single-key cryptography these get irreversibly combined. "No one had ever separated them and treated them as different entities until two-key cryptography made it inescapable that they were fundamentally different. We seized on that, and the work on the theory of authentication, the development of authentication codes, and the application of the authentication channel really began at that point."

This work has been stimulating and very productive, notes Gus. Although Sandia didn't discover two-key cryptography, "I think probably we've made more applications of the two-key concept than anyone anyplace else," he says. "The fact is that the best work of my career has come just recently. There isn't the slightest doubt that the most substantial technical work of my entire time at Sandia has been done in the very last few years, the last four or five, in fact. And that's topsy turvy," he says, referring again to his "backwards," late-PhD career.

"What is new and different — it's kind of the capstone of my professional career — was the discovery, the theoretical description, and the exploitation of the authentication channel," he says. "If anything I've done will outlive me, it's probably that."

Gus regrets only that he's not still at the beginning of his career. "Authentication is one of the most important topics in applied mathematics right now. We are surrounded by the need to authenticate messages." For paper documents there exists a long tradition of elaborate and legally accepted protocols by which we establish authenticity. "Now our society has changed very rapidly" to the electronic-information age, in which information "has no meaningful physical existence." And yet all the functions of physical documents need to be retained: secrecy, authentication, signature, notarization, proof of content, certificate of receipt, and so on. Says Gus, "The solution of that collection of problems is the most important task in applied mathematics now."

The twinkle in his eye tells you that, as always, he relishes the challenge.

## Eye's the Word

# Personal Protective Equipment Is Just That: Personal

One pair of safety glasses is good enough for Mike Stark (1232). But he's picky about getting just the right pair. So he bought safety glasses privately. And he wears them every day at work and at home.

They're a lightweight glass shield for his eyes. Good idea. . .

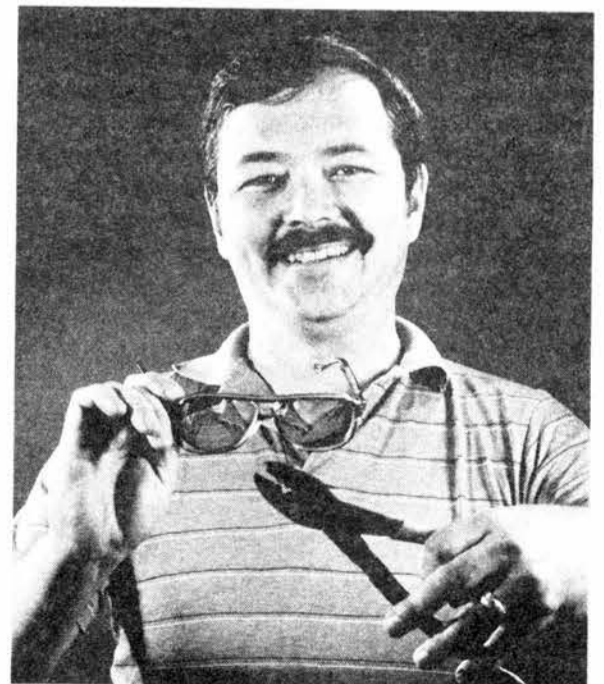
One day last fall, he shut his home air conditioner down for the season. "The wiring looked like a handyman's special," he remembers. "I decided to rewire the controls, so I turned off the circuit breaker. Then I went up on the roof to cut the cabling. I took my wire cutters and snipped. Flash! The green wire shorted, blowing molten metal in my face, up to my scalpline and down my neck. It was the wire clippers; the tip had melted." Mike's safety glasses still have a spray of metal nuggets embedded in them. But his eyes were saved.

No one could have predicted that his house was terribly miswired. "The green [coded for earth-to-ground] wire was actually hot — it carried 110 V," he says. "Not only that, it was wired on the wrong side of the circuit breaker. The only reason I didn't get electrocuted by the 20-amp wire was because my wire clippers had rubber handles and I had them in contact with the grounded chassis of the outlet."

Al Fine (3442), the safety representative for the 1200 organization, notes that "Safety is a two-way street. Some things don't stop at work. Personal protective equipment is issued for work, yet concern for safety off the job is just as important." Al says that Sandia strongly supports any initiative that carries over safety precautions from one environment to the other.

In fact, Al wears his Sandia-issued safety glasses everywhere. "I don't bother changing them because this way I'm covered anywhere," he says. "And today there is a greater choice of frames, the lenses are thinner and lighter, and the glasses look pretty good."

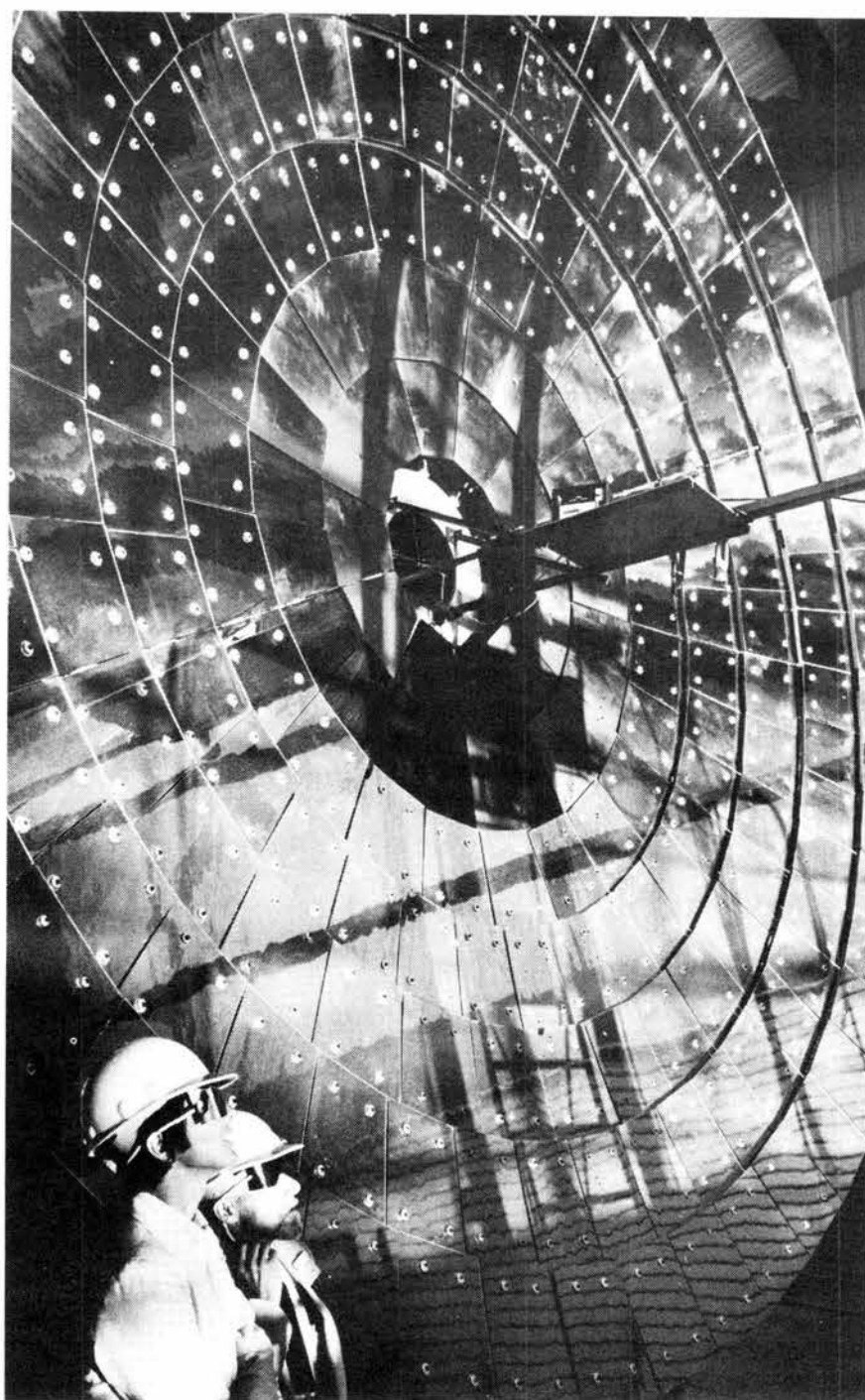
"Your supervisor must decide if your job at work requires safety glasses," Al says. "The rules and procedures, and even the application forms, are in the Safety Manual — that's the big green book in your supervisor's office."



A SAFE BET paid off for Mike Stark (1232), who wore his safety glasses at home while working on a miswired air conditioner. His wire clippers melted, but his eyes were spared.



TOUR OF POWER TOWER (6226) capped the DOE/SNL Solar Thermal Technology Conference for Donna Fitzpatrick (foreground), assistant secretary for conservation and renewable energy. John Holmes (6226) accompanied her at the Sandia site. The highest-ranking woman in DOE, Donna delivered the keynote speech — an overview of the environment for energy research — at the conference, held in June at the Marriott. Not shown is Don Schueler (6220), who conducted the tour of CRTF, the wind turbine, photovoltaics, and AL.



### Medical Corner

## “Positive Approaches” Film Festival Coming

Medical's TLC staff is sponsoring a film festival during the week of July 21 for all employees and their families. "These are excellent films on positive lifestyle behaviors," says TLC Coordinator Susan Harris (3330). The series will be shown from 12 to 12:30 p.m. in Bldg. 815 (outside the Tech Area). Brown bag lunches are welcome — especially if they're nutritious.

The first film in the series is an overview of a healthy lifestyle. Each of the other films is about one specific lifestyle behavior.

The schedule is:

Monday, July 21 - "Health & Lifestyle: Posi-

tive Approaches to Well-Being"\*

Tuesday, July 22 - "To Your Heart's Content: Positive Approaches to Fitness"

Wednesday, July 23 - "Weighing the Choices: Positive Approaches to Nutrition"

Thursday, July 24 - "Taking It In Stride: Positive Approaches to Stress Management"

Friday, July 25 - "For a Change: Breaking Old Habits and Making New Ones"

\*Some employees have already seen this film in safety meetings but might want their families to see it, to see it again themselves, or to see the rest of the series.



CERTIFICATE OF COMPLETION of the Education with Industry program was recently presented to 1st Lt. Keith Harris (right) by George Stone (310). As a student in the program — sponsored by the USAF Institute of Technology — Lt. Harris has been assigned to Systems Research Dept. 310 since last September. He spent his time at Sandia studying U.S. nuclear weapon technology and development philosophy, and is now assigned to the Air Force Technical Applications Center at Patrick AFB in Florida.

## Take Note

Representatives from Japan's New Energy Development Organization (NEDO) and Hitachi, Ltd., visited Sandia recently to discuss their plans for implementing an ion beam hydrogenation process for improving photovoltaic conversion efficiency of polycrystalline silicon solar cells. Janda Panitz (1834) and Don Sharp (1831) briefed the visitors on their work (and that of Carl Seager, 1132) in solar cell hydrogenation (see LAB NEWS, March 1, 1985). In turn, the Japanese gave four presentations covering their research and future scale-up activities. Goal of the Japanese is to achieve a polycrystalline solar cell efficiency level of 16 percent — as opposed to the 14 percent record level achieved by Janda, Don, and Carl last year. NEDO's current development budget for solar energy conversion is 7.4 billion yen (approximately \$44 million). The organization, based in Tokyo, serves a role similar to that of the Solar Energy Research Institute in the U.S.

## In Form & Informed

*Q. What is the difference between jogging shoes and aerobic shoes? Can I wear jogging shoes in my aerobics class?*

A. Jogging and aerobics are very different activities that place different demands on your feet, ankles, and legs. Jogging involves movement in a forward direction only, but aerobic exercises require you to move in several other directions as well. Because of these different movements, shoes have been developed with different features.

Jogging shoes provide support for moving forward only, as well as shock absorption; they are not designed to provide support for sideways movements, such as jumping jacks or the dance steps commonly used in aerobics classes. Aerobic shoes have been especially designed to provide lateral (sideways) stability, as well as shock absorption for exercising on hard floors. I highly recommend that you wear aerobics (or good court) shoes for aerobics and leave your jogging shoes for jogging. By wearing jogging shoes for aerobics classes, you may ruin your jogging shoes; even worse, you run the risk of injury.

Conversely, be sure to wear jogging shoes, not aerobic shoes, for jogging because they provide the more stable heel support and more shock absorption in the heel, both of which are needed for the forward motion of running.

Here are some tips on buying fitness shoes:

- Try on several different pairs to find one that feels comfortable immediately. Jog around the shop for several minutes to make sure you have enough toe room. When you bring them home, jog around on carpet to again check the fit. If they don't fit and if you have not actually worn them outside or in class, many stores will allow you to return them.

- Shop for shoes late in the day after you've been moving around for several hours. Try on shoes with the same athletic socks you'll be wearing to exercise. (Yes, socks are very important for shock absorption.)

- Unless you run more than 20 miles per week or do aerobics more than five times per week, stay away from the most expensive models. Most moderately priced shoes have all the technical features of expensive shoes. Expect to pay between \$20 and \$45 for a good pair of shoes.

The October issue of *Runner's World* magazine is a comprehensive shoe survey that rates jogging shoes. *Shape* magazine runs (usually in the springtime) a similar survey for aerobics shoes.

Laurel Traeger Mackinnon  
Exercise Physiologist

### Most Basic Research



The current issue of *Life Sciences* contains a paper under the title: "Alternating lateralisation of plasma catecholamines and nasal patency in humans." Our science editor says this means "why you can breathe up one nostril at a time."

*New Scientist*



## New Technique Predicts Glass Crack Growth Rates

A stone thrown from a passing vehicle's wheels hits your car's windshield, leaving a tiny imperfection in the glass. As weeks go by, you become aware of small cracks radiating out from the spot the stone hit. The cracks continue to grow. How long will it take these cracks to lessen your ability to see through the windshield? Or weaken the glass substantially?

A group of Sandians working on a related problem has come up with a way to predict how rapidly glass — or ceramic materials — will crack when exposed to various stresses, humidity, and chemical environments. Glass has many applications (see below), so that capability is quite important.

The group received the 1985 Award for Outstanding Scientific Accomplishment in Metallurgy and Ceramics from DOE's Office of Basic Energy Sciences (see LAB NEWS, Oct. 25, 1985). Award recipients were Terry Michalske (1845), Bruce Bunker (1846), George Fisk (8353), David Haaland (1823), and Mike Knotek, formerly of Sandia and now Director of the National Synchrotron Light Source, Brookhaven National Laboratory.

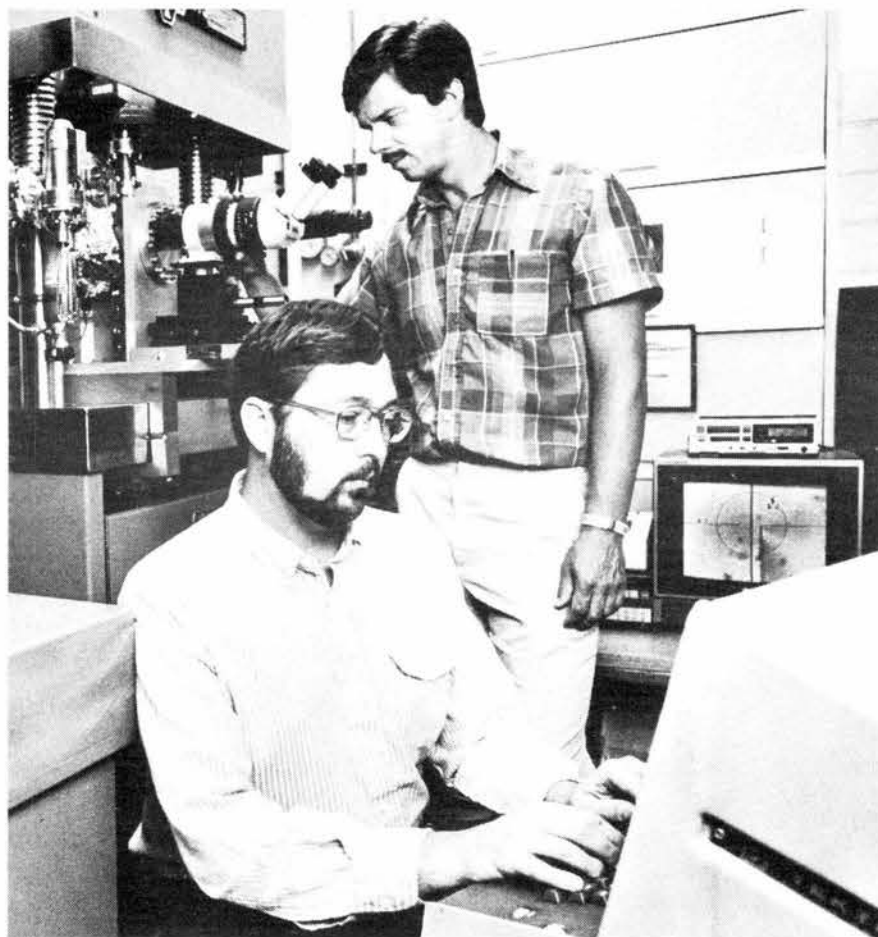
Key to the ability to predict glass crack growth rates is the use of small clusters of silicon and oxygen atoms (called model chemical compounds) to study the behavior of silicon-oxygen-silicon bonds that form glass — especially those bonds located at the opening of a crack. Bonds located at the "crack tip" are highly distorted because of strains being applied to them; they behave differently than normal bonds that make up bulk glass. (See related story for what happens when glass cracks.)

During the past several years Sandia researchers have been working primarily toward verification of their own model chemical compounds. Reliable model chemical compounds can be tailored to simulate the physical characteristics of bonds located at crack tips (or elsewhere) — an important feature because direct observation of actual crack tips is not possible.

To verify the compounds, Carl Melius (8343) and Steve Binkley (8233) used a computer to build a simulated cluster of silicon and oxygen atoms that featured the same kind of physical distortions as glass crack tip bonds. They then compared the bond behavior calculations with the chemical behavior of the model chemical compounds.

Theoretical and experimental studies performed on the models also predict chemical compound formation that will occur on glass crack surfaces while fractures grow. These predictions were confirmed by experiments conducted at the National Synchrotron Light Source at Brookhaven.

In the studies, glass test samples were fractured in controlled environments and the crack surfaces



GLASS RESEARCHERS use high-vacuum mechanical test facility to study crack propagation in glass. A computer-controlled hydraulic load system is used to stress glass samples, and various chemicals are introduced to study their effects on glass strength. Here, Bill Smith (1845, foreground) uses a computer to signal the desired load, while Terry Michalske (also 1845) eyeballs the glass sample through a microscope. The video screen (right) records what's happening during a test.

were exposed to an ultraviolet beam. This caused the compounds that were formed during crack growth to pop off the surface so they could be identified, counted, and compared with predictions.

To predict the nature and rate of chemical attack on actual crack tip bonds, project team members analyze crack-causing chemical reactions on the model chemical compounds. They then test pieces of glass in a variety of chemical environments to determine how closely actual crack growth parallels the predictions.

Results of these experiments are cranked into a mathematical model that calculates the effects of different types of chemical reactions on glass strength. The mathematical model is confirmed by exposing additional test samples of glass to different levels of stress, pressure, and humidity.

"We record the glass behavior over time and extrapolate long-term behavior up to 10 years in the future," says Terry Michalske. "Before we verified the reliability of the model chemical compounds, we couldn't accurately predict glass behavior beyond a period of several months. We also believe we'll be able to predict strains that different kinds of glass ought to survive without cracking, and whether cer-

tain glasses are likely to be crack-resistant.

"This capability should help designers produce more reliable optical fibers, insulators for high-performance batteries, solar collector covers, underwater windows, and other glass or ceramic items," he continues. "People who design solar panels, for instance, will know precisely what their design limitations are."

It's hoped the glass crack growth research can eventually be used to identify ways of treating glasses with thin coatings — possibly polymers — that slow or stop crack growth, or ways of reliably healing cracks that develop in glass. The Labs' crack growth models may also be useful for determining the long-term strength behavior of brittle materials such as aluminum oxide and magnesium fluoride.

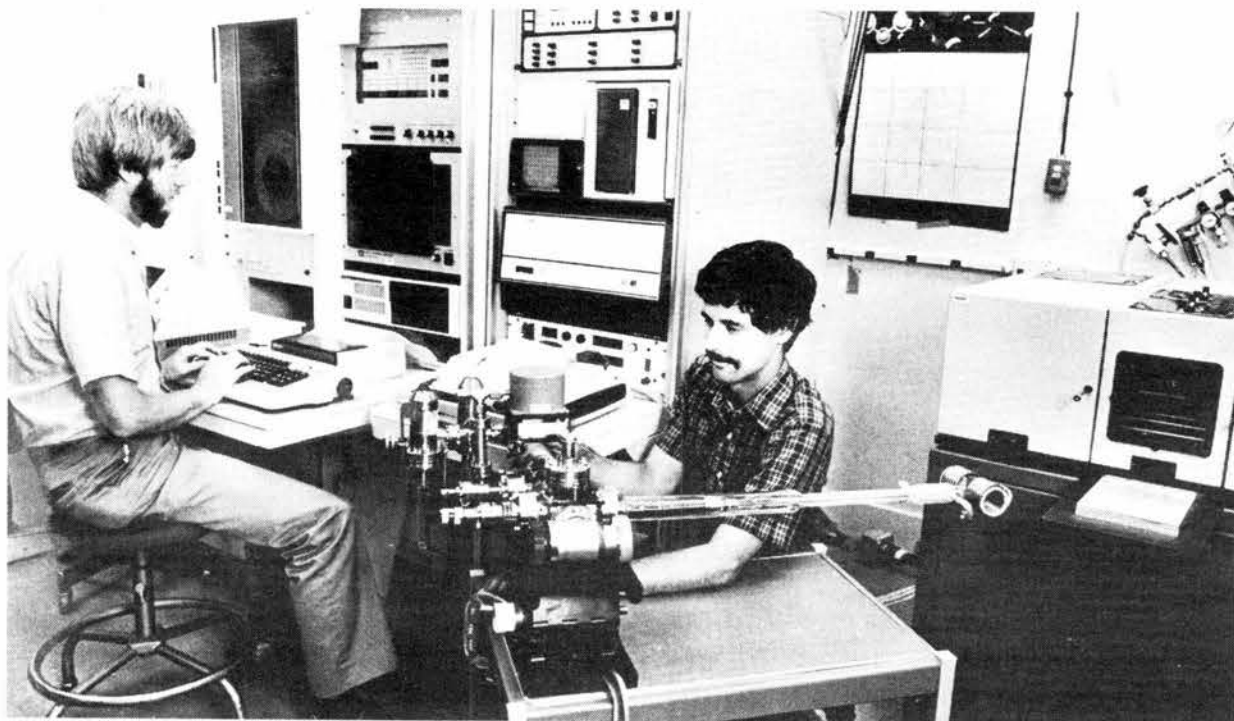
### Glass Cracks: How They Happen

What happens when glass cracks? First, water molecules enter a tiny pre-existing crack on a piece of stressed glass. This can easily occur because (1) moisture is present in the atmosphere unless precautions are taken to eliminate it, (2) almost all glass has tiny flaws on its surface that have potential for growing into cracks, and (3) glass is under tensile stresses in essentially all applications.

Second, the chemical reaction between water molecules and silicon and oxygen ruptures the silicon-oxygen-silicon bond that forms glass. Once started, the reaction can propagate through a piece of glass unless moisture is removed or stresses on the glass are reduced to an acceptable level.

A water molecule's ability to donate both electrons and protons to neighboring sites drives the crack growth phenomenon. Other molecules besides water have the electron/proton donor trait, and also can weaken glass bonds and cause cracks to grow. Ammonia, hydrazine, and formamide, for instance, attack glass in the same manner as water.

Even a small amount of moisture will reduce the strength of glass by about two-thirds. Cracks' growth speed is determined by the actual amount of moisture, combined with pressures and strains being applied to glass.



DAVID HAALAND (1823, left) and Bruce Bunker (1846) work with lab equipment that artificially creates strained bonds in glass samples to simulate glass crack tips. Bruce adjusts equipment that introduces various liquids or gases that interact with the sample during a test. Sample is placed in infrared cell (between coils at end of tube), then moved into spectrometer at right to study effects of chemical reactions with the strained bonds. David's computer drives the infrared spectrometer, which is used to monitor reactions during testing.



# Events Calendar

- July 18 — Summerfest, Friday Evening Gala: "Broadway Elks" (rock-a-billy, blues jump), 5:30-9 p.m., Civic Plaza.
- July 18-Sept 30 — Exhibit, Ye'ii, Ye'ii Bichai and Navajo dry painting ceremonial tapestries; 9 a.m.-4 p.m. Mon.-Fri., 10 a.m.-4 p.m. Sat.; Maxwell Museum of Anthropology, 277-4404.
- July 18-August 17 — "Tierra Sagrada," a bilingual, romantic musical about life and love along the Rio Grande; 8 p.m. Fri.-Sat., 3 p.m. Sun.; La Compania de Teatro de Albuquerque, El Nuestro Teatro, 256-7164.
- July 18-28 — Contemporary Women's Art, exhibit; reception for artists, 2-4 p.m., July 6; South Broadway Cultural Center, 898-1320.
- July 18-27 — "On Golden Pond"; 8:30 p.m., Fri.-Sun.; Corrales Adobe Theatre, 898-3323.
- July 18-August 10 — "Top Girls" by Caryl Churchill; 8 p.m., Fri.-Sat.; 6 p.m., Sun.; Vortex Theatre (Buena Vista & Central), 247-8600.
- July 18 — Original jazz, Alan Lewine Septet; KiMo Theatre at 8:15 p.m.; \$6.00 at the door, \$4.50 at Giant Tickets.
- July 19 — Concert, Santa Fe Desert Chorale Concert II, 8 p.m., Keller Hall, 988-2282.
- July 19 — Summerfest, German Festival: "Deutsches," 4-10 p.m., Civic Plaza.
- July 19-20 — Rio Rancho Fine Arts and Crafts Festival; 10 a.m.-7 p.m. Sat., 10 a.m.-6 p.m. Sun.; Haines Park (Rio Rancho), 823-2210.
- July 20 — Arts in the Parks, Jazz Sunday: Elmer Kane and the Music Makers, Joan Steel Quartet, Alan Lewine Septet; 1-5 p.m., free, Roosevelt Park.
- July 20 — Outdoor Pop Concert with New Mexico Symphony Orchestra, sponsored by Abq. Parks & Recreation Dept. and KiMo Theatre; 6-9 p.m., Los Altos Park; \$5.00, tickets available at KiMo, Civic, Dukes' Will-Call Office, and Papa Toti's.
- July 22 — KiMo Kid Flicks: "Nanook of the North" and "Mickey Mouse Nostalgia"; 1:30 p.m., KiMo, 848-1374.
- July 24 — KiMo Kid Flick: "Jason and the Argonauts," 1:30 p.m., KiMo, 848-1374.
- July 24 — Summerfest, Noontime Concert: "Talisman" (easy listening, jazz, top 40), 12-1 p.m., Civic Plaza.
- July 24-27 — "Mother Goose Is Loose," Albuquerque Children's Theatre; Rodey Theatre, 888-3644 or 277-3121.
- July 25 — Concert, Chamber Orchestra of Albuquerque; music by Joplin, Thomson, and Taylor; 8:15 p.m., Albuquerque Little Theatre, 247-0262.
- July 25 — Summerfest, Friday Evening Gala: KDEF presents Paul Britt with the music of Count Basie, 5:30-9 p.m., Civic Plaza.
- July 25-27 — Albuquerque Arts and Crafts Summer Show; 10 a.m.-8 p.m. Fri.-Sat., 10 a.m.-5 p.m. Sun.; Agriculture Exhibit Hall, NM State Fairgrounds, free, 831-9574.
- July 25-27 — "1776," (musical recreating moments preceding America's Declaration of Independence), Albuquerque Civic Light Opera; 8:15 p.m. (Sun., 2:15 p.m.), Popejoy Hall, 345-6577.
- July 26 — Santa Ana Pueblo Feast Day, 75 dancers, featuring the Corn Dance, 867-3301.
- July 26 — Movie matinee to benefit ACRA (Albuquerque Communications and Rescue Association): Disney animated full-length feature, "Gulliver's Travels" 1 p.m.; "My Friend Flicka" 3 p.m.; for both shows, \$5.00-adults, \$1.50-children under 12; KiMo, 298-0881.
- July 26 — Summerfest, Americana Festival, 5-10 p.m., Civic Plaza.
- July 26-27 — Palomino Horse Show, Horse Arena, NM State Fairgrounds, 869-3161.
- July 27 — Rio Grande Institute fund-raiser: silent auction and film, "Sundagger"; 6 p.m., KiMo, 277-2965, 842-5808, or 242-9598.
- July 27 — Arts in the Parks: Albuquerque Municipal Band, Buster Willow, Ehwas Desert Belly Dancers, Lewie Wickam, more; 2-6 p.m., Academy Hills Park (Eubank & Layton NE), free.



THE OLD ANNEX POOL isn't what it used to be. Coronado Club members may remember the five years or so in the late 70s when this pool (located south of the Club) was *the* place for lap swimming, water safety instruction, and diving/water polo/swim team practice. Returned to the Air Force a few years ago, it has, alas, fallen on hard times. Bid it adieu before it becomes an enlisted men's rose garden or some such.



TOTE THAT BARGE! Actually, these four heavy equipment handlers in Remote Areas Maintenance and Test Support Division 7818 are able to move a section of the 6' x 200' shock tube in Coyote Canyon with relative ease, thanks to two sets of hydraulic jacks beneath the 35,000-lb., 40-ft.-long, steel section. Shock tube facilities are used to investigate blast-wave effects on full-scale components, with a charge of high explosives placed at one end and the experiment at the other. Before tests, shock tube sections sometimes must be moved five to ten feet backward or forward while alignment is maintained, reports Ernie Duran, supervisor of Test Support Section 7818-4. The jacks, with rollers on the top side, lift the steel section enough to clear the two cradles on which it rests. Then handlers, with help from the jacks' rollers, slide the big pipe to the desired position. Pipe pushers are (l to r) Candido Archuleta, Evaristo Gutierrez, John Clay, and Luberto Ortiz.

- July 27 — Chamber Orchestra of Albuquerque, selections from "The Red Back Book," 8:15 p.m., Albuquerque Little Theatre, 247-0262.
- July 27 — Jazz at Madrid, Alto Madness of Richie Cole; Old Ballpark Pavilion, 3-7 p.m.; \$5.00 at gate, \$2.50 for kids and senior citizens; advance tickets at Giant Tickets.
- July 30 — Very Special Talent Show, 7-10 p.m., KiMo, 764-1525.
- July 31 — Summerfest, Noontime Concert: "Bayou Seco" (Cajun & Southwestern music), 12-1 p.m., Civic Plaza.
- July 31-Aug. 2 — Kachina Morgan Classic Horse Show, Horse Arena, NM State Fairgrounds, 753-3696 or 898-1223.
- August 1 — Summerfest, Friday Evening Gala: "Max Apodaca Band" ('40s, '50s, Dixie), 5:30-9 p.m., Civic Plaza.
- August 1-Sept. 1 — Senior Citizen Artists, opening reception Aug. 1, 1-4 p.m., KiMo Gallery.



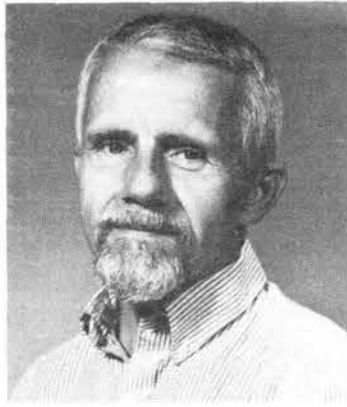
EVARISTO GUTIERREZ (7818) operates a hydraulic jack that will help move a large shock tube section before a test. Once the section is lifted from the cradles on which it rests, rollers on the jack's top side facilitate moving the steel section backward or forward.



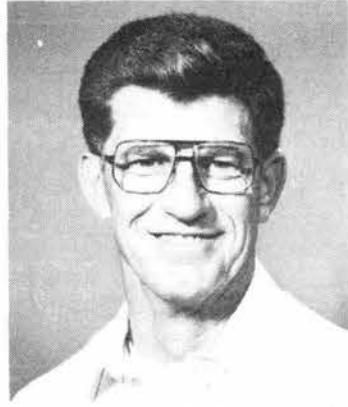
# MILEPOSTS

## LAB NEWS

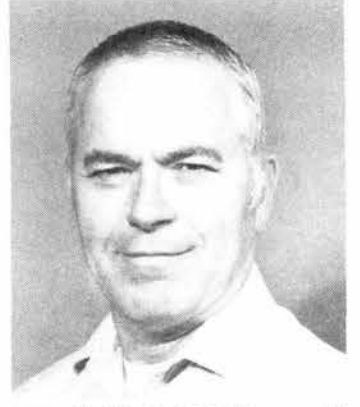
JULY 1986



John Holmes (6226) 10



Charles Riney (2857) 25



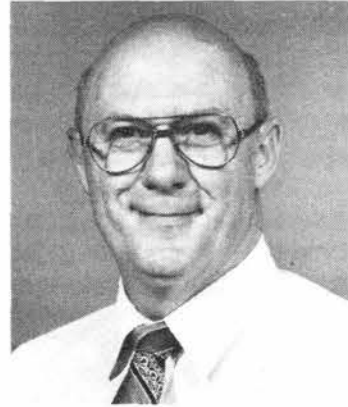
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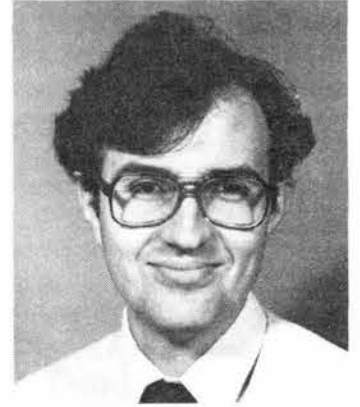
G. C. Hollowwa (3463) 40



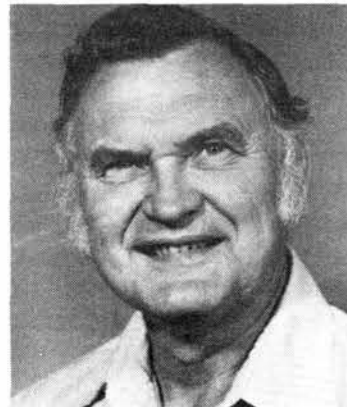
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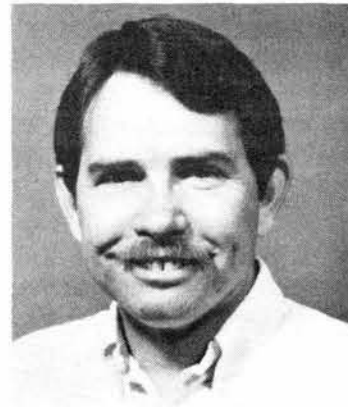
George Perkins (2321) 25



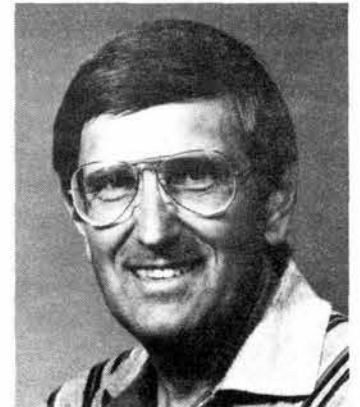
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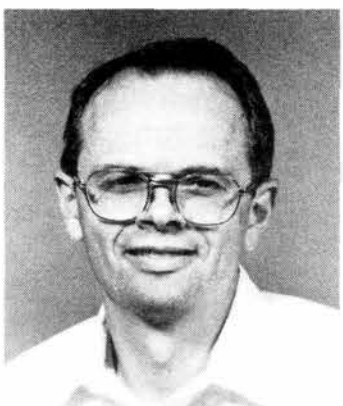
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Michael Fletcher (315) 10



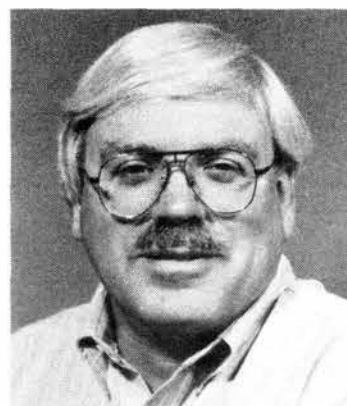
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John Rosborough (2361) 25



Charles Johnson (5217) 30

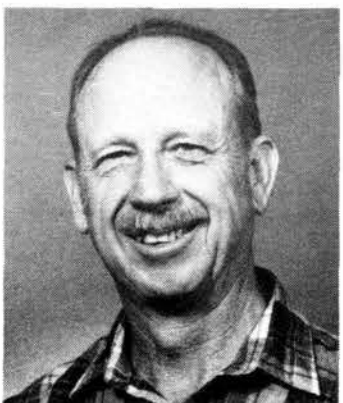


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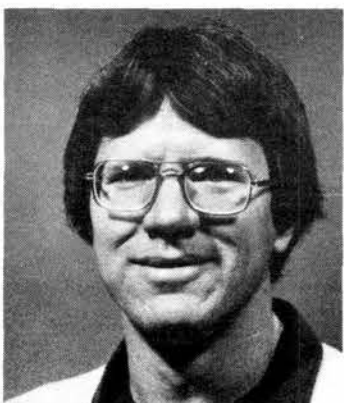


John Souza (5154)

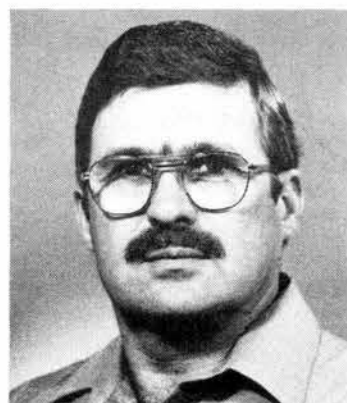
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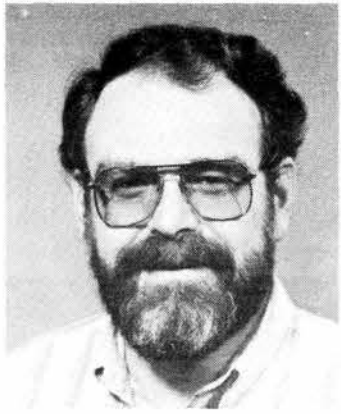


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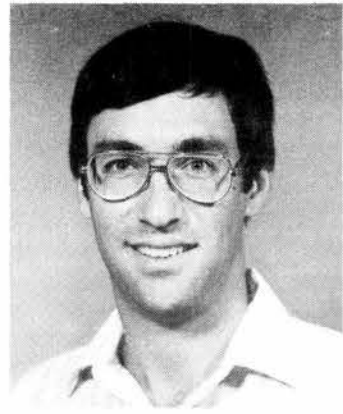


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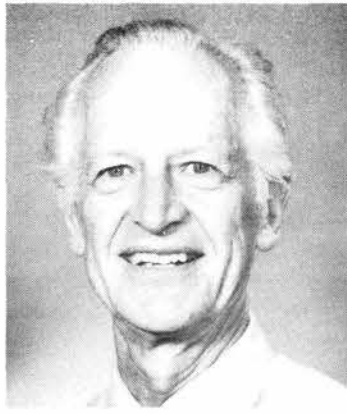




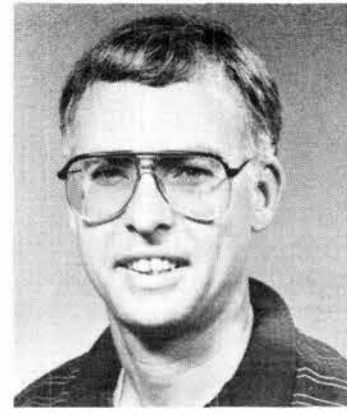
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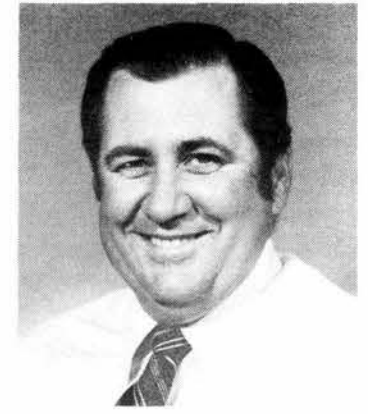
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Chester Ricker (3552) 35



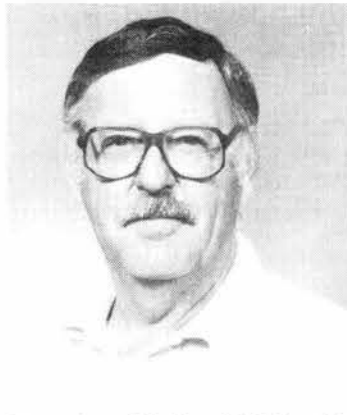
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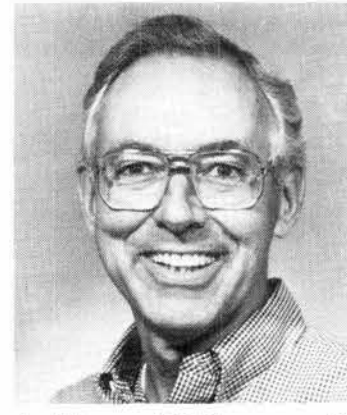
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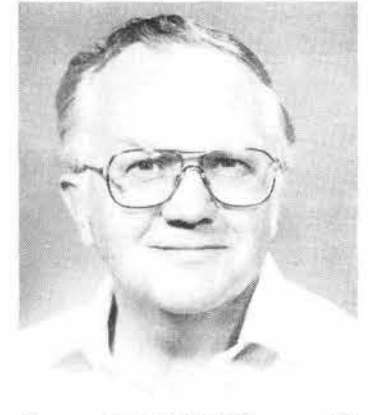
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Theodore Pfeffer (7135) 35



Jack Leroy (2543) 30



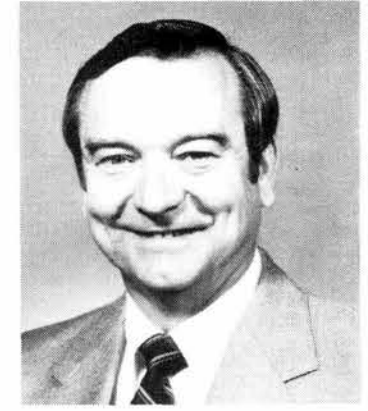
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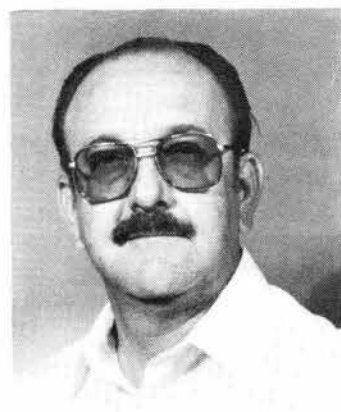
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Judith Mead (7213) 10



Ed Barkocy (5153) 25



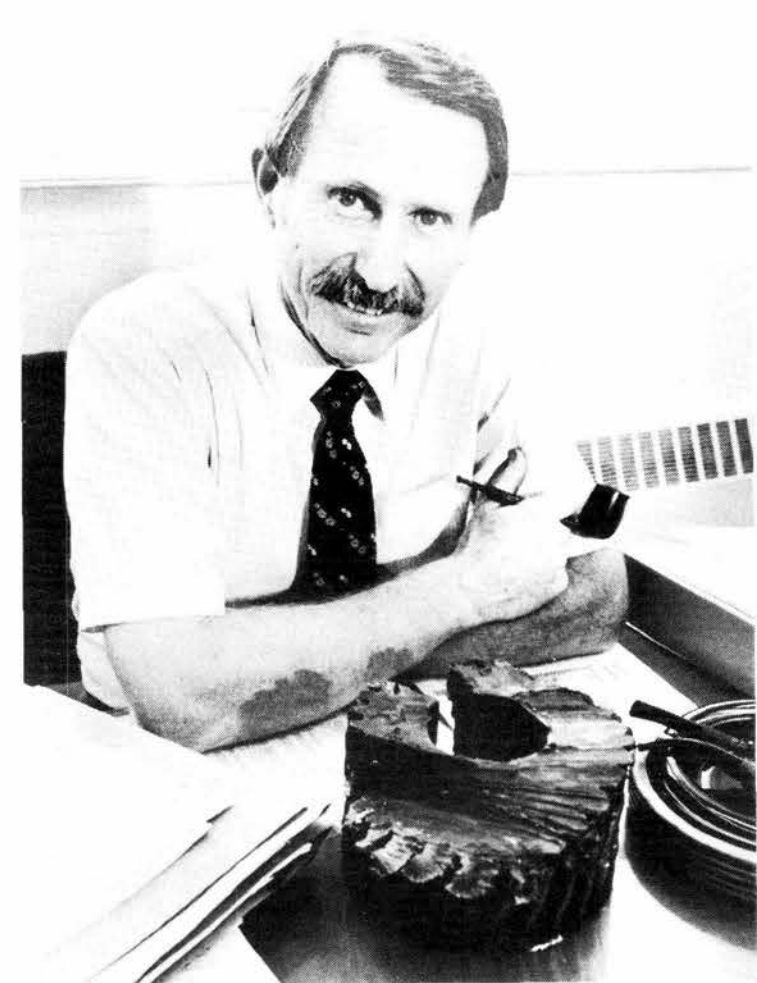
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Marv Torneby (3530) 25



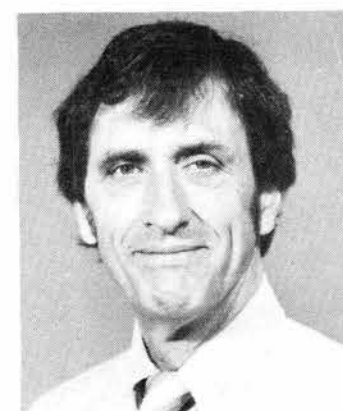
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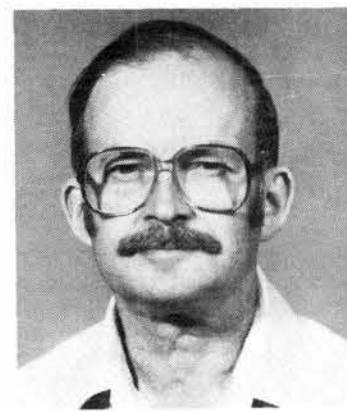
Tom Lane (7530) 30



Bob Frazer (324) 25



Martin Tierney (6312) 15



Ken Glibert (7112) 20



Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.

## Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8 1/2 by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same ad.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

## MISCELLANEOUS

PORTABLE COLOR TV. Rose, 299-9333.

GIRL'S BICYCLE, Schwinn, 5-sp., Cruiser, for off road biking, \$125. Mogford, 898-1416.

VACUUM CLEANER, Filter-Queen, \$50; floor polisher, electric, Shetland, \$20; wrought iron scone, \$25; wrought iron wall-mount entry stand, \$10. Stevens, 299-6086.

15 BLACK LAVA ROCKS, for landscape, free, you pick up. Moriarty, 884-4106.

PIANO, Kohler-Campbell console, 43" high, maple finish, matching storage bench, \$1000. Pettit, 292-0789.

GO-CART, without engine, \$55; with engine, \$100; Toro lawn mower, \$55. Riley, 869-2119.

WROUGHT IRON screen/storm door, 3-0, RH, dead bolt, \$150. Domme, 255-0133.

EPSON MX-80 computer printer w/manual/Graftrax, \$225 cash or trade for stereo cassette deck or Radio Shack Pen Plotter CGP115 or FP215; playpen, \$30. Barnette, 292-5186.

TENT, 8' x 10', Hillary (Sears), family-size, sleeps 4 adults, external frame, 6'6" center height, \$150 new, asking \$100. Schkade, 292-5126.

REFRIGERATED air conditioners, window/wall-mount models, assorted sizes. Bauer, 266-8480.

LA-Z-BOY recliner, \$85; twin bed w/frame, \$125. Mazze, 299-4568 after 5.

PENTAX SPOTMATIC SLR, extra lenses, filters, case, complete outfit, \$125; large oak dining table w/6 chairs, \$100 OBO. Bayless, 281-9197.

AQUARIUMS: 20-gal. w/stand, complete, \$60 OBO; two 10-gal. w/stand, complete \$75 OBO. Mozley, 884-3453, leave message.

WASHING MACHINE, heavy duty, 3-cycle, Frigidaire, needs some work, \$65. Keese, 299-1327.

TRANSCEIVERS, 2-meter, hand-held, Wilson 1405 w/local crystals, extra battery, Touch-Tone pad, charger, case, \$100 ea. Hartwig, 298-5048.

MICRO TRANSCRIBER, Sony, w/foot control unit, dynamic earphone, \$95. Johnson, 884-8250.

ROTTWEILER PUPPIES, 4 males, show and breeding prospects, parents OFAd, whelped 4/26. Griego, 864-2624 after 6.

THREE KITTENS, recently born inside Sandia compound, free to loving homes. Chao, 821-1949.

AIR CONDITIONER, 2-sp., 6500 cfm DD, used one season, no rust, new pads, \$300 OBO. Crass, 281-3889.

BED FRAME, new, queen; Bull's Eye putter; Bag Boy golf cart; guitar and case; sleeping bag. Branstetter, 292-6369.

DRAFTING TABLE, wooden, fully adjustable, w/machine, \$200 OBO. Marek, 292-2547.

PARACHUTE RIG, complete: skydiving rig and jumpsuit, Ram-Air Strato Star, modified 26' conical reserve, SST backpack, new Silly suit, \$650 OBO. Demos, 294-6492.

BEDROOM SET: dresser, nightstand,

headboard, mirror; coffee table, end table, Mediterranean style, walnut-veneer finish. Helling, 281-5536 or 294-0582.

STEP BUMPER for Toyota or Datsun pickup w/ball, \$45; Bentwood rocker, \$50; H&P "Citation" golf club, \$35. Stang, 256-7793.

DARKROOM EQUIPMENT incl. enlarger, print washer, dryer, etc., \$200; Farberware indoor electric BBQ, \$25; new sunlamp, \$25. Horton, 883-7504.

CB, Midland, 23-channel, AM/SSB base with power MIC, TVI filter, 5/8 ground plane antenna, \$125 OBO. Patteson, 822-1722.

FORMAL DINING SET, Thomasville, solid cherry table/chairs/hutch; king-size bed w/mahogany headboard; couch/chairs; two cemetery lots, Sandia Memory Gardens, below market, \$700. Eagar, 298-0522.

LEROY LETTERING SET, 80 to 500, \$50; electric typewriter, Sears Scholar, power return, \$60. Chorley, 296-1454.

WROUGHT IRON 24" table and chairs, \$45; couch/matching chair, seldom used, \$225; all-wood coffee table, \$30; console stereo, \$75. Vigil, 821-8059.

DRESSER, end tables, coffee table, lamps, dinette, plastic and metal shelves, bird cage. Bohannon, 822-0060.

WESTERN SADDLE, \$300; coffee table made from old oak dining table, \$75. Harley, 345-2294.

MISC. tables, kitchenware, TVs, tires, screen doors, cabinets, drapes, shelves, much more. Griffin, 294-5702.

KING-SIZE MATTRESS, \$150; girl's 20" bicycle, \$25. Atencio, 831-7196 after 5.

BOWLING BAG and Star Track ball, \$20; men's bowling shoes, size 9, \$8. Smith, 299-7151.

KING-SIZE WATERBED w/6-drawer pedestal bookcase headboard, \$300, will help disassemble and drain; dining room table, \$40. Barnes, 881-6808.

ALASKAN CAMPER, pop-top, 10', for 3/4 or 1-ton pickup, ref., stove, heater, \$1500 OBO. Wray, 345-0153.

GOLDEN RETRIEVERS, AKC, first shots, 12 weeks, \$125. Heffelfinger, 299-2233 or 255-5495.

KITTENS, free to good home, born June 8, 4 gold (3 male), 1 white (male). McGovern, 291-9952.

TRAVEL TRAILER, 22' Monterey, fully contained, sleeps 6, refrigerator inoperative, shower, toilet, heater, AC, \$2900. Schowers, 822-8494.

PORTABLE DISHWASHER, no leaks, \$75. Spiak, 292-5235.

PROFESSIONAL HAIR DRYER, Hoover; hanging lamp, blue glass globe; audio cassette holders, can be wall mounted. Michele, 298-8576.

KITCHEN TABLE w/6 chairs; apartment-size stove, propane or gas. Maestas, 831-4072 after 5:30.

POOL TABLE, 1" slate w/extras, \$525; air compressor, Sears, 2-HP, 20-gal. tank, \$325. Stephens, 822-8584.

DISHWASHER, Frigidaire, portable, front loader, \$150 OBO. Anderson, 299-8676.

CASEMENT WINDOW HARDWARE: cranks, locks, screens, etc.; inside storm windows; call for sizes and prices, reasonable. Luikens, 881-1382.

CEMETERY LOTS (4), Sandia Memory Gardens, cost \$425 each, will accept reasonable offer. Vandt, 255-0685.

CAPTIVE AIR PRESSURE TANK, 19-gal., vertical, new. Loucks, 281-9608.

FOOT MASSAGER, electric, circulates hot or cold water, Dazey, used once, \$12. Barr, 821-5870.

WATERFORD CRYSTAL: salad bowl, \$100; S&P shakers, \$50; sugar/creamer, \$80; La-Z-Boy rocker recliner, \$50. Gosselin, 243-1629.

GOLDEN RETRIEVER PUPPIES, AKC, born June 19, ready July 31, \$220; Curtis Mathes console TV, needs work, \$30. Morrison, 298-0347 or 294-6407.

CHINA CABINET, English-made, light walnut, \$185; B&W/85 19" TV, \$50; plate glass mirror, 48" W x 24" H, \$10; medicine cabinet, 48" W x 9" H, \$10. Ramel, 821-0475.

MARLIN-39A 22LR, \$150; Ruger 32 H&R Mag. 200; RWS 177-cal. air rifle, \$100; TASC0 3 x 9 compact scope, \$50; 44 and 38 dies, \$25. Zamora, 865-0737 after 6.

HARVEST TABLE, solid maple, 25-1/2" x 70", each drop leaf 10-1/2" wide, total width 46-1/2". \$300. Hughes, 299-6674.

GE ROOM AIR CONDITIONER, installs easily in window, used one summer, \$100. Key, 298-7988.

GENERATOR, Sears, 2000-watt, \$350. Douglas, 281-9843.

FOUR TIRES, P195/75R14, M/S, \$5 each. Benton, 877-2473.

MIRROR, 68" X 22", \$20; ball clock, \$12; two narrow shelves w/brass brackets, \$15; large 4-way stereo speakers, \$130/pr. Caskey, 296-6372.

AQUARIUM, 10-gal., complete, \$15. Herther, 298-4823.

BROILER OVEN, sun lamp, salon-style hair dryer, diaper pail, potty chair, stroller, Sears 165R13 tires. Phipps, 299-8490.

FORMICA, new, approx. 45 sq. ft., marble, \$60; stereo AM/FM cassette tape player, \$40. Gendreau, 268-3436.

SOLID OAK BEDROOM SET, 5 pieces, \$1700; antique mahogany bedroom set, 3 pieces, \$500, both sets include mattress. Bliach, 294-9569.

HOME EXERCISE GYM, Lean Machine, 48 weightlifting exercises, \$250 OBO; 4800 cfm DD evaporative cooler, \$150 OBO. Dionne, 262-0160.

DINETTE SET, walnut finish, Formica top w/leaf, 4 padded chairs, \$175. Martin, 822-8260.

TWO MAGNUM SAILBOARDS, beginner/intermediate, complete w/accessories, \$550 OBO; new ignition coil for '83 Toyota, \$30. Bentz, 299-3448.

OUTBOARD MOTOR, 2-cyl., Sears, \$50. Stromberg, 255-6131.

TWO HOLLEY 4-barrel carburetors, \$100 each OBO. Mozley, 884-3453, leave message.

## TRANSPORTATION

'79 PLYMOUTH Horizon, 4-sp., cylinder head cracked, all or any parts, make offer. West, 281-3460.

'83 ULTRALIGHT, Quicksilver, Cayuna 430, instruments, helmet, radio, other extras, \$1500. Vaughn, 298-5919.

'68 DODGE Dart, original 318 engine, below 100K miles. Gabaldon, 266-0028.

'69 VW bug, new motor and upholstery, trade for sailboat or powerboat. Rose, 299-9333.

BOAT and trailer, 1980 18' Hawaiian inboard/outboard, tri-hull, open bow, 140 HP 4-cyl. Chev. motor, new tires and spare on trailer, extras. Morrison, 299-4757.

'67 FORD pickup w/camper, AT, 6-cyl., year-old brakes, \$2000. Leatherman, 268-3754.

'66-68 VW bug, running, reasonable. Baumgarten, 256-9606.

'68 MG Midget, new top, paint, and interior, needs minor work, \$1000 OBO. Lynch, 268-4489.

'85 NISSAN Maxima GL, 4-dr., V6, front wheel drive, loaded, sunroof, leather, 14K miles, \$17,500 new, will sell for \$12,750 or trade. Collins, 266-5868.

'83 TOYOTA 4X4 pickup, short bed, w/camper shell/racks, 33K miles, AM/FM cassette, tube bumper, hitch, \$6800. Bentz, 299-3448.

'81 CHEV. Citation, AT, AC, tint, AM/FM cassette, low mileage, \$2600. Ukena, 299-4314.

'68 CAMARO, 327, AT, PS, original throughout, \$5000 OBO. Brusseau, 294-9563.

'81 CHEVETTE, 2-dr., 47K miles, AT, one owner, \$2800. Brown, 884-6848.

'74 OLDS Delta 88, 4-dr., new paint, upholstery, top, AT, PS, AC, \$800 OBO. Crass, 281-3889.

'83 YAMAHA Venture, black, bought new April 1985, 1.2K miles, \$4650 (negotiable). Falls, 822-1870.

'66 PONTIAC Bonneville Brougham, 4-dr., V8, all power, original owner, 75K miles, \$950. Daniel, 299-4761.

'57 CHEV. wagon, 4-dr., new interior, make offer. Pierce, 299-2801.

'76 EL CAMINO, engine recently overhauled, \$3000. Harley, 345-2294.

'79 CHEV. 3/4-ton, 6 cyl., 4-sp., 80K miles, \$2500; IH660 tractor, 6 cyl. diesel w/loader, \$2250. Muirhead, 281-2925.

'67 FORD F350 camper special, dual wheels, custom sleeper between cab and bed, \$2150 OBO. Wray, 345-0153.

'76 BRONCO, 302, V8, PB, 83K miles, alarm system, tow bar, roof rack, stereo, \$3700. Gibbs, 281-3639.

BICYCLES, two Trek 560s, brand new (repossessed from Sport 1). Loucks, 281-9608.

'80 TOYOTA Tercel, hatchback, AC, low mileage. James, 294-6837.

'77 DODGE Colt, not running, good for restoration, call for appointment to see near Valencia, \$300 OBO. Servis, 865-7629.

'82 FIREBIRD, AC, PS, PB, AT, AM/FM cassette, cruise control, cloth interior, \$5500 OBO. Nickerson, 299-3101.

'77 FORD pickup F150, 39K miles, one owner, PS, PB, 6-cyl., AM/FM cassette, second gas tank. Champion, 299-0163.

'83 HONDA XL600R motorcycle, 1.8K miles on/off road, \$1300. Snyder, 883-4702.

'79 FORD Mustang, AC, AM/FM cassette, 4-cyl., manual transmission, 76K miles, \$2300. Umbriano, 823-2629.

BOAT, 16' SeaKing, fiberglass w/trailer, 50-hp Johnson motor, \$1995 OBO. Ramel, 821-0475.

'73 BRONCO FWD, 302 cu. in. engine, 4-brl. carburetor, AT, PS, AC, \$3950 OBO. Sanchez, 294-4604 after 4.

'80 VOLVO DL, 2-dr., AM/FM, AC, cruise control. Williams, 292-1210.

'79 FORD Fairmont wagon, rebuilt AT, PB, PS, new struts, one owner, \$1500. Cleland, 299-1263.

'72 SUPER BEETLE, gray on gray, stereo, new engine, brakes, tires, transmission and interior, \$2300. Ashment, 823-2780.

'74 MUSTANG II GHIA, AC, PS, AT, AM/FM cassette stereo, new tires, 70K miles, \$1550. Key, 298-7988.

'84 CHEV. S-10 pickup truck, 4 X 4, PS, PB, 4-sp., V6, 42K miles, \$5200. Johnson, 892-3343 or 884-1249.

'83 MAZDA 626LX, 4-dr., AC, AT, PS, sunroof, AM/FM cassette, electric windows/locks/mirrors, low mileage, \$6800 OBO. Hellmann, 821-0357.

'71 KARMANN GHIA, turquoise w/cream vinyl top, \$1800 OBO. Evans, 892-0620.

'82 HONDA Silverwing/Interstate 500, \$1750 OBO. Husa, 298-5764.

BICYCLE, Takara, 10-sp., 19" frame, 26" wheels, \$100. Gendreau, 268-3436.

'84 SUZUKI DR125, less than 1K miles, boots/helmet, \$600. Lewis, 296-7896.

'76 OLDS Cutlass Supreme, PS, AT, AM/FM, AC, one owner, \$750. Moore, 821-502.

'74 MAZDA RX4, manual transmission, 81K miles, rebuilt RX7 engine, new radials, new brakes, \$1050 OBO. Biedscheid, 294-6564.

'84 PLYMOUTH Voyager, 30K miles, 5-sp., AC, large gas tank; '66 Mustang, cherry red w/white vinyl roof, \$2000. Cieslak, 294-2383 after 7.

'83 DATSUN PULSAR, low mileage, 5-sp., sun roof, PS, PB, AM/FM, \$5250. Miller, 822-0008.

'74 GMC 4WD JIMMI, AC, AT, snow tires, luggage rack, low mileage, \$1800 OBO. Prindle, 292-3334.

## REAL ESTATE

5/8 ACRE in Sherwood Forest, below appraisal, camp or summer home site. Hill, 294-7534.

2-BDR. W/GUEST CABIN, Lake Whitney, Tex., 2 baths, CH&A, furnished, shop, garden, fruit and nut trees, \$49,500. Richardson, (817) 694-5434.

CABIN, Deer Lake Estates, Jemez Mtns., 2-bdr., 1 bath, loft. Wenk, 298-1411.

VOLCANO CLIFFS, 90' x 150' lot, low down. Mazze, 299-4568 after 5.

RESORT CABIN in Ruidoso, on trailer, move to your site, electricity, sleeps 6, needs some repair, \$5500 cash. Furman, 298-9264.

1983 14' x 64' mobile home, 2-bdr., 1-1/2 baths, adult section Cedar Crest Park, many extras. Helling, 281-5536 or 294-0582.

3-BDR. HOME, 2100 sq. ft., Dietz Farms, 3-car garage. Harley, 345-2294.

2-BDR., Parkland Hills SE, completely remodeled, bath/kitchen w/decorator accents, 1040 sq. ft., open floor plan, large lot w/landscaping, 10% assumable FHA. Foly, 268-0412.

3-BDR., 1-bath, Sw, \$52,000. Padilla, 831-3500 after 5:30.

3-BDR., Heritage Hills NE, 1406 sq. ft.,

greatroom, fireplace, carpets, drapes, double garage. La Cueva HS, \$84,900, 9-1/2% assumable loan. Reda, 821-3817.

2-STORY HOME, Jemez Corridor, 1900 sq. ft., 3-bdr., 2-bath, den, LR, 22' x 28' garage/workshop, outbuilding, 1.08 acres, \$79,000, refinance. Becker, 1-829-3696.

3-BDR., 1-3/4 bath, LR, DR, den w/FP, 1820 sq. ft., 10% FHA, \$106,500. Orrell, 821-8742.

2-BDR. MOBILE HOME, partly furnished, near Base at Shaw Mobile Home Park, 11000 Gibson SE, \$8800. Atencio, 881-6945.

3-BDR., remodeled, all brick, 1450 sq. ft., \$79,900, \$13,900 down, \$692 PITI, 10%, no qualifying, 2332 Stevens NE, Stanalonis, 298-7903 or 294-9871.

3-BDR. HOME in Heritage Hills, professionally landscaped, solar, double garage, 1-3/4 bath, priced at FHA appraisal. Kreinbrink, 822-1627.

4-BDR., 1-3/4 bath + 1-2-bath, mountain home on 1 acre, 6 minutes east of Tramway, solar, deck, oak cabinets, wood accents, \$124,500. Turpin, 281-5933.

4-BDR. HOFFMAN BRICK, Menaul Wyoming, LR, DR, 1-3 4 bath, den, FP, garage, solar. McVeety, 294-5568 or 299-5718.

## WANTED

POWER GENERATOR, 13 amp or higher output; acetylene torch. Pritchard, 299-3543 after 5.

DROP-LEAF TABLE and 2-4 folding chairs. Hill, 294-7534.

TRAIL BIKE, 125-275cc, reasonable condition and price. Blackledge, 294-6030.

LIVE-IN NANNY to care for 3 children and do housekeeping, female, non-smoker, English-speaking, references required, benefits, salary. Rockwell, 884-4206.

OUTBOARD MOTOR, 2 or 3 HP in excellent condition. Vaughn, 298-5919.

WHISKEY BARRELS or similar barrels for planters. Keese, 299-1327.

FURNISHED HOUSE APARTMENT by faculty couple, fall semester. Baumgarten, 256-9606.

AIR COMPRESSOR, small piston-type, yellow, made by Sharpe in Los Angeles, AEC sold as surplus about 1954. Stamm, 255-2640.

TWO-WHEEL utility trailer. Schwoebel, 298-4295.

REFINISHER to work on sewing machine cabinet and bench. Burkhardt, 266-1927 after 5.

MUSIC STAND, good condition. Brigham, 293-6914.

GOOD HOME FOR CAT, black male w/white chin, chest, and paws. Crane, #2 Heather Heights Lane, Tijeras.

INTERFACE CARD for Commodore-64 and C. Itoh Model 8510A printer. Nelson, 255-5709.

WALL TENT w/stove. Palmer, 296-2551.

ROOMMATE, own room and bath for non-smoker, NE Heights home, \$225/mo + 1/2 utilities, available Aug. 1st. Levin, 299-0891.

SHEET MUSIC STAND, good condition. Vandt, 255-0685.

LEADS ON BURGLARS — of items stolen two days before Mother's Day from home on Wellesley; mink furs, Sandia retirement gifts, silver RCA disk player w/disks, luggage, \$500 reward. Brown, PO Box 5564, ABQ, NM 87184.

MEN'S 19-INCH BIKE, 10- or 12-sp., good condition. Montoya, 296-4268.

HOUSEMATE, Juan Tabo/Central area (5 min. from Labs), 3-bdr., 2-bath, den w/FP, double garage, pets. Nordeen, 296-7898.

CINDER BLOCKS and red bricks, all sizes and any quantity. Aragon, 881-4795.

## WORK WANTED

LAWN MOWING by college junior, reasonable, free estimates, references. Lanes, 299-6298.

HOUSESITTING and/or yard and pet care by college junior, references. Cook, 296-3064.

## LOST

HIGH-FASHION prescription sunglasses, on bike route from Wyoming Gate to Medical/Gate 4. Hill, 294-7534.



# Calling All Buckaroos — It's Western Night!

COWBOYS AND COWGIRLS will be out in full force on Western Night, Saturday, July 26. Back by popular demand, this unforgettable event starts out with a big buffet, served from 5-8 p.m., featuring BBQ ribs and chicken and all the good stuff that goes with barbecue, like baked potatoes, full salad bar, and assorted desserts. The tab for all these goodies is a low, low \$6.95. Then it's stomp time to the music of — who else? — those good old Isleta Poor Boys. Get that buggy hitched up and roll on over to the Club office to make your reservation — or give them a call at 265-6791.

LOOKING FOR A FAST LUNCH with really good fast food? We have just the place for you. The Club has added an outdoor grill right next to the snack bar on the patio. Your favorite sandwiches — Polish sausage, hamburgers, hot dogs, etc. — are ready in a flash . . . and 50-cent beer is available to wash them down. They're cooking up a storm seven days a week from 11 a.m.-2 p.m., and Club manager Sal Salas invites you to join the happy crowd that's already discovered how to eat lunch in a half hour.

SWIMMING UPSTREAM? Coronado Aquatic Club members never do. CAC fans will be glad to know they have some more chances this month to watch the team in action. They're up against a group from Rio Rancho tomorrow morning at the C-Club pool, starting at 8:30. Next week on Wednesday, July 23, CAC members have an away meet at the YMCA Mountainside facilities, set for 4:30 p.m.. The grand finale comes up July 26-28, when the Aquatic Club competes in the City Championships. They welcome all cheerers-on, so come on out and watch them splash their way to victory!

FILET MIGNON OR POACHED HALIBUT — That's your choice of entrees at next Friday night's (July 25) two-for-one dinner special. Where else in town can you get two fabulous dinners for a bargain \$14.95? Nowhere, that's where! Afterward, that famous south-of-the-border group, Together, makes music for your dancing pleasure from 8-midnight. On Aug. 1 the two-for-one special features prime rib or lobster. Loosen up after dinner with country/western lessons from 7:30-8:30 so you can take off on the dance floor, with Western Flyer providing the music from 8:30 on. Don't forget to call in your dinner reservations, so the Club knows how to stock the larder.

GO WEST, YOUNG MAN — That's advice for the Thunderbird Roadrunners. They're spinning those RV wheels out to the south shore of Bluewater Lake July 29-31. To find out what goes on at T-Bird camp meetings and what's the fastest way to Bluewater, contact wagonmasters Duane Laymon, 822-1759; Tom Brooks, 344-5855; or Bill Minser, 299-1364.

EVERYBODY'S INVITED to a Family Night/Open House on Saturday night, Aug. 2. A low-price buffet starting at 5 p.m. offers hamburgers, pizza, hot dogs — the sort of culinary delights that appeal to every member of the family. Then a lineup of cartoons called "Disney Parade" lights up the big screen at 6. It's fun for everybody — members and non-members alike — so mark your calendar right now.

THE CLUB'S FORMULA for Sunday brunches is a real winner if large turnouts are any indication of success. Let's face it, though; not too many restaurants in the Duke City serve Sunday brunch for the unheard-of price of \$4.95, with children half price! And the low tab gives you a choice of ham, sausage, baron of beef, scrambled eggs, hash browns, full salad bar, and that famous green chile. Manager Sal invites everybody — not just members — to the next brunch buffet bash, scheduled for



JOHN DAPOLITO, chef at the C-Club's new patio grill facility, dishes out a couple of good-looking sandwiches. The best fast food in town is available at the grill from 11 a.m.-2 p.m. seven days a week.

Aug. 3. Make your brunch reservation with the Club office, 265-6791.

JOIN THE HAPPY WANDERERS by signing up for one or more of the scintillating sojourns lined up for this fall by the C-Club Travel Committee.

*San Francisco/Wine Country* — This nine-day tour (Sept. 13-21) lets you explore the many attractions of San Francisco and takes you to California wine country too. Throw in visits to Muir Woods north of SF, Sausalito, and South Lake Tahoe, and you have yourself a most memorable journey! Your headquarters most of the time in San Francisco is the Howard Johnson Embarcadero, which puts you close to Fisherman's Wharf and all that wonderful seafood. Price is \$565, plus \$158 round-trip air fare/person (double occupancy). Since the "City by the Bay" is everybody's favorite, this one will fill up fast; better hotfoot it over to the Club office to make your reservation.

*Laughlin/Lake Havasu City* — The deadline for this trip — Aug. 15 — is closer than you think. So you closet gamblers and English history buffs had best reserve your space now to avoid disappointment. This four-day adventure Oct. 13-16 takes you to the gaming tables of Laughlin, Nev. and to Lake Havasu City, Ariz., where you'll see London Bridge and explore the quaint English village next to the bridge. The \$150/person fee covers three nights at Laughlin's Edgewater Casino/Hotel, one free breakfast or lunch buffet of your choice, round-trip motorcoach fare, and refreshments along the way.

*The Ozarks* — You'll visit all sorts of attractions in three states during this Oct. 18-24 getaway. The \$637/person price includes round-trip air fare to Tulsa, six nights' lodging, admission fees for all kinds of museums along the way, hillbilly and popular music shows, the Great Passion Play, Shepherd of the Hills outdoor drama, and much, much more. Reservation deadline is Sept. 15.

*Aspencade* — No question about it, this one is a photographer's dream trip. Catch all the fall colors on this tour to southern Colorado and northern New Mexico from Sept. 27-30. The \$145/person tab covers round-trip charter bus fare, two night's lodging in Telluride, one night's lodging in Pagosa Springs, three continental breakfasts, one lunch on the bus, and dinner at Rancho de Chimayo on the last day of

the trip. Picture-taking stops are planned all along the way, so you'll have plenty of time to admire that tremendous fall foliage.

*Canyon de Chelly* — Spectacular scenery is yours Oct. 25-26 if you sign up for one of the Club's most popular "weekenders." And no wonder . . . those awesome red cliffs are a splendid background for golden cottonwoods at that time of year. Included in the \$98/person price are charter bus fare, one night at the Thunderbird Lodge, a picnic lunch at Wheatfields Lake, a jeep tour of the canyon, and a stop at the well-known Hubbel Trading Post.

## Deafening Earful



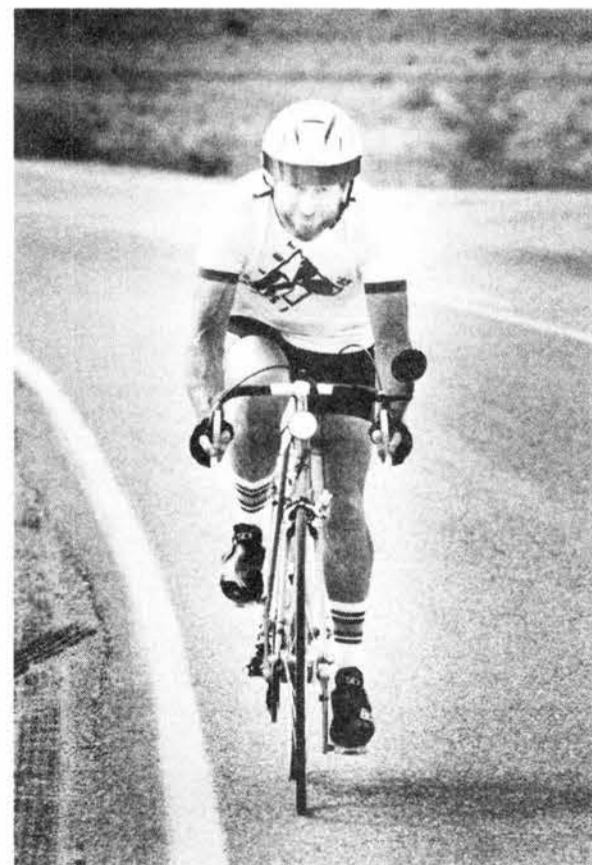
The doctor's perennial bugbear — a foreign object worked expertly into an ear or up a nose — has gone hi-tech. Once, the offending objects were peanuts and aspirins; now button batteries are adding a more serious dimension to the problem. . . . Batteries produce serious complications such as perforation of the eardrum, exposure of the bone in the ear canal, destruction of the ossicles, and paralysis of the facial nerve. The injuries are so severe because impaction of the battery causes weeping. The fluid provides an electrolyte bath and the currents generated as a result cause electrolysis of the tissue and alkaline burns. The addition of ear drops only hastens the process.

*New Scientist*

## Fun & Games

*Tennis* — The Coronado tennis courts were the site of a Sandia Tennis Association tourney on June 28 and 29. Charlene Schaldach (2627) defeated Judy Hansen (5163) in the women's singles. In the men's A final, Jeff Tsao (1111) defeated Larry Schneider (1251). In the men's B, Dave Clauss (6442) defeated Dave Smallwood (DMTS, 7544). In the women's doubles, Marge Gerber and Charlene Schaldach won the round robin. Larry Schneider and Louis Kuratko defeated Jeff Tsao and Mark Tucker (7544) in the men's doubles.

*Triathlon* — Ed Harley (6227) has qualified for the Bud Light U.S. Triathlon Series, a national championship to be held Sept. 27 at Hilton Head Island, S.C. Ed placed in the over-60 division and is now gearing up for a 0.9-mile swim, 24.8-mile bike race, and a 6.2-mile run. The finals will be televised in an hour-long special on ESPN.



WEEKDAYS IT'S SOLAR POWER, but weekends it's pedal power for Ed Harley (6227), who bikes 12.5 miles from his Valley home to the KAFB East O'Club in preparation for the Bud Light U.S. Triathlon Series National Championship in the fall. Co-sponsored by AT&T and Coca-Cola, the race has \$55,000 in prize money up for grabs. Ed, who just reached his 40th anniversary at Sandia, qualified for the over-60 group, one of 20 amateur divisions in the triathlon.